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ENVIRONMENTAL IMPACT STATEMENT

draft



United States
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CHAPTERS VIII AND IX

ERRATA SHEET
CHAPTER VIII
KAIPAROWITS E.I.S.

Page VIII-17: After the next to the last sentence in the last paragraph, add, " . . ., which could be injurious to human health."

After the final paragraph, add sentence, "Impacts to the environment would be the same as the proposal described in Chapter III."

Page VIII-21: After last sentence of top paragraph add, "There is also the danger to human, animal and plant life should acid spills occur."

Page VIII-26: After third sentence, first paragraph, add, " . . ., which could be hazardous to human life."

Page VIII-31: After last sentence of third paragraph, add, "The depth of the landfill is not known at this time."

Page VIII-48: Last sentence of page change, "Also" to "However."

Page VIII-49: After the last sentence of second paragraph, add the sentence, "The salt drift, however, would be considerably lower."

Page VIII-250: The tenth word, third line in the next to the last paragraph should be "litter."

Page VIII-309: Last word, fourth line, first paragraph should be "silica."

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KAIPAROWITS

ENVIRONMENTAL IMPACT STATEMENT

CHAPTER VIII

ALTERNATIVES TO THE PROPOSED ACTION

Draft

CHAPTER VIII

ALTERNATIVES TO THE PROPOSED ACTION

SUMMARY

Technical alternatives

Generating plant designs

Changes in location of various components might occur during final design engineering. These changes would not increase the area required for each component, and would create the same impacts to the environment as described in Chapter III.

Alternate stack marking included 24 hour strobe lights, which would increase visual impact during night hours.

Four alternative particulate removal systems and seven alternative SO^2 removal systems were evaluated by Bechtel Power Corporation for the participants. All of these alternatives would result in virtually the same impacts to the environment as would the primary proposal.

The participants considered the following for waste disposal: the southwest corner of the proposed plant site as an alternate location for bench-top landfill, an alternative bench-top disposal method, canyon landfill and disposal in the mine. The alternate bench-top site would require an additional 4,000 cubic yards of excavation and increase the surface disturbance by 2.3 percent (10 acres). The alternative method of bench-top landfill would involve spreading wastes behind a berm; this would result in increased erosion and visual impact. Considerable construction and excavation would be required for a canyon landfill. Necessary diversion of the natural drainage would disturb more acres of vegetation and possibly eliminate wildlife in the canyon. Approximately two miles by one-half mile of the canyon floor would be buried. Waste could also be injected into mined-out areas as a slurry; this would require 675 acre-feet annually of additional water, and could ultimately contaminate adjacent ground water. Sufficient space in the mine would not be available for at least ten years; however, this method may reduce subsidence.

The participants considered alternate sites, alternative designs, and alternate pipelines routes for the water supply system. One alternate site would be at Romana Mesa. This site would require an additional ten miles of pipeline, and the disturbance of 27 more acres when compared with the proposed location. It would also have an adverse visual impact. Another alternate site, at Warm Creek, is within one mile of the proposed site, and would involve the same kinds of impacts as the proposed action. Alternative designs of water intakes include a trench intake, which would cause disturbance because of underwater blasting and excavation, and a jack-up off-shore platform, which would involve technical problems, create a navigation hazard to boaters, and an adverse visual impact to the lake aesthetics. An alternate pipeline route would cross Smoky Mountain, it would be longer than the proposed route and would result in more disturbance. A route up Nipple Creek along the proposed highway would involve less total disturbance.

Alternate locations for the reservoir and various pond lining materials were also considered. These alternatives would have the same impacts to the environment as would the primary reservoir proposals.

Alternate cooling systems include cooling ponds, spray ponds, wet-dry cooling towers, and dry-cooling towers. Cooling ponds would eliminate environmental effects of drift and save 20 mw of power, but they would require lining, an additional 16,000 acres of land, and an increased water consumption of 16,500 acre-feet annually. Spray ponds would require less land than cooling ponds but 95 acres more than cooling towers. They may also cause fogging and icing downwind, and would use as much energy as the proposed method. Wet-dry cooling towers require 20 to 30 percent more energy to operate. They would have less drift loss and would use less water, however, they are relatively unproven. Dry cooling towers would not use water and therefore, would not cause environmental disturbance associated with proposed wet cooling towers. Experience with these systems is limited, and possible effects on weather conditions due to release of heated air is unknown.

Six alternative limestone processing and handling methods were examined. These systems involved processing at the plant, at plant and mine, at the quarry, the use of lime or limestone, and purchase from an outside supplier. Processing at the quarry site would result in an additional surface disturbance of 22 acres. Processing at the quarry would also require coal and an additional transmission powerline. Purchasing from an outside supplier would involve no surface disturbance in the impact area of the proposed Kaiparowits project, but would require long distance haulage. If raw limestone were used instead of lime, a kiln and the coal used to heat the limestone would not be needed.

Coal mine design

Alternative coal mining and transportation methods were examined and none would have any lesser adverse impacts to the environment than the proposal.

Transmission system

Routes

Kaiparowits to Eldorado

Fourteen alternative routes were examined from Kaiparowits to Eldorado. These alternatives could: increase surface disturbance by six to 50 acres; increase annual sediment deposition into the Paria River by one acre-foot per year; result in an adverse visual impact in the areas of Cottonwood Canyon, Cockscomb Ridge, Beaver Dam Mountains, and Rainbow Garden; reduce more habitat for desert bighorn, Gambels quail and antelope.

Kaiparowits to Phoenix

Seven alternate routes from Kaiparowits to Phoenix were analyzed. Impacts of the alternatives would either be the same as the proposal described in Chapter III, or would disturb 120 to 400 more acres than the proposal. Alternate routes would have an adverse visual impact in the Echo Cliffs and Black Canyon Trail areas, and would intrude on the nesting areas of the rare and endangered peregrine falcon and bald eagle.

Kaiparowits to Moenkopi to Mohave

From Kaiparowits to Moenkopi to Mohave, nine alternate routes were examined. These alternatives, when compared to the proposal, would disturb an additional 80 to 1,240 acres of vegetation, reduce the habitat of bighorn sheep, and have an adverse visual impact to Detrital Valley, or the area between Flagstaff, Arizona and Grand Canyon, or Lake Mead National Recreation Area, or Sacramento Valley.

Mohave to Serrano

Seven alternate routes from Mohave to Serrano were examined for environmental impacts. These alternatives when compared to the proposal would either have similar impacts to the environment, or create adverse visual impacts in the Sacramento Mountain area, damage archaeologic sites in Martinez Canyon and Salt Creek, or partially destroy some bighorn sheep habitat in the Santa Rosa Mountains.

Direct current and alternative voltage levels

The proposed system of two 500 kv AC lines was compared with 765 kv AC lines, one ± 600 kv DC lines and two ± 600 kv DC lines. One 600 kv DC line could replace two 500 kv AC lines, but it cannot be integrated into AC systems without AC converters. The 765 kv AC line would require wider towers than a 500 kv AC line. Two 600 kv DC lines would carry all that the Kaiparowits Power Plant could generate plus an additional 2,000 mw.

Use of existing transmission systems

Kaiparowits to Eldorado route

The existing single circuit line would be upgraded to double circuit towers. This alternative would lessen visibility from hard surfaced roads and would not cross Indian reservation land.

Kaiparowits to Phoenix

This alternative would involve upgrading two 500 kv lines to one 765 kv

line with one 500 kv line left in place, or upgrading one existing 500 kv line to double circuit 500 kv towers. Soil disturbance would be increased during tower reconstruction. The greater mass of 765 kv towers would be more intrusive on the landscape. Systems reliability would be reduced, and construction costs would double.

Glen Canyon Dam to Pinnacle Peak Substation

Soil disturbance would not be any greater than new construction. Construction costs would increase four times over new construction due to disassembly of existing lines.

Kaiparowits to Mohave

An existing 500 kv line would be upgraded to a double circuited 500 kv line. Severe soil disturbance could be caused during disassembly of existing lines. There would be a decrease in the system reliability.

Undergrounding

Placing the transmission lines underground could increase costs 10 times. Also, undergrounding of 600 kv and higher voltages is not technically feasible due to heating problems. Burial would eliminate visual impact, but would involve surface disturbance because of the need for a trench.

Line spacing

A line spacing closer than 2,000 feet would reduce the number of disturbed acres, but system reliability could be reduced.

Alternate transportation routes and access roads

Three alternate highway haulage routes were considered. The East-Widtsoe Junction route would eliminate the need to haul material through Bryce Canyon National Park, but would be difficult to travel during winter months. The Paunsaugunt Plateau

route would also by-pass Bryce Canyon National Park, but would result in scars that could be visible from the park. A third alternative would result in hauling through Bryce Canyon National Park.

Alternate methods of transportation

Limestone transportation by railroad or conveyor belt would require construction over a 60-mile route. Slurrying and pumping limestone would require about 149 acre-feet annually. Water in the slurry may affect the limestone, causing a reduction in its binding characteristics and lowering its effectiveness in the SO_2 scrubbers. Crushing and grinding limestone at the quarry site would reduce needed highway transportation. This method would require a large water system, electrical transmission powerline and about 150 tons of coal per day hauled from Fourmile Bench.

Implementation alternatives

Regardless of the implementation alternative considered, impacts to the environment would not be any different than those identified and discussed in Chapter III.

Capacity greater than 3,000 mw

No specific plan has been presented by the participants for increasing the size of the operation above 3,000 mw. However, studies by the participants indicate that up to 25,000 mw capacity could be built at the site without exceeding the three-hour sulfur dioxide standard. Increased water consumption could increase the salinity at Lee's Ferry, Arizona less than one miligram per liter.

Alternative of constructing plant at Nipple Bench

The Nipple Bench alternate would be similar to the Fourmile Bench proposal as far as air and water quality is concerned. However, 1,170 acres of wood products and 20 to 70 head of deer would be lost if the Fourmile Bench Proposal were implemented.

Other alternative generating sites - Kaiparowits Plateau

Three other sites besides Nipple Bench were also analyzed to determine their suitability for a power plant. These sites were dry Bench, John Henry Bench and Horse Flat. All of these sites would be visible from Bryce Canyon National Park and Page, Arizona.

Alternate generating station sites outside Utah

Sites for coal-fired power plants in California, Arizona and Nevada were considered as alternatives to the Kaiparowits Power Plant. New coal-fired plants cannot be built in California unless there is a reduction in either air quality standards or present sources of pollution.

To increase capacity of coal-fired power plants in Arizona and Nevada would require additional water which is not presently available in the amount needed to meet increased generating capacity.

Alternate limestone quarry sites

Five alternate sites were considered. The best alternative to Johns Valley would be the Canaan Peak site.

Alternate actions by government agencies

New town

Six new community sites were investigated. All sites had some limitations, but the East Clark Bench site appeared the most favorable. It is the only site, except the East Clark Bench alternate, now served by a paved all-weather highway. It has sufficient space for expansion and the best potential for attracting additional business and industry. The lower elevation, warmer climate and closer proximity to Lake Powell make it more attractive for a town site.

New highway

The Kaiparowits Planning and Development Advisory Council recommended a road from Cannonville to Glen Canyon City (East Clark Bench). The same route would

be used whether the plant is located at Fourmile or Nipple Bench. Alternatives would have the same impact to the environment as the primary proposal with exception of the alternate route up Last Chance Creek. The Last Chance Creek alternative would result in disturbance of tropic shales, which are highly erosive.

Alternate means of meeting project objectives

Purchase power from outside Kaiparowits market area

Purchase of power outside the Kaiparowits market area could only occur if surpluses were available or if utilities were willing to provide additional capacity. This would not occur in the foreseeable future as all utilities are facing problems of siting and financing.

Oil and gas

Natural shortages and dependence on foreign imports preclude oil and gas as a realistic alternative.

Nuclear power

The alternative of using nuclear power is economically feasible, but scheduling of nuclear plants is uncertain at this time.

Geothermal

Use of geothermal energy for generating 3,000 mw is not a technically feasible alternative at this time.

Solar energy

Use of solar energy to produce 3,000 mw is not technically feasible at this time.

Investments in energy conservation services

Conservation programs require public, governmental, and company cooperation; long-term planning on a national and regional basis is needed to bring about

long-term changes in consumption patterns. If this cooperation was in effect now, construction could be deferred 10 years. If it took five years to develop this cooperation then the power plant could be deferred five years.

Advanced generation and transmission systems

Due to technical problems, none of the advanced generation and transmission systems would be available soon enough to either be incorporated in or offset the Kaiparowits Power Plant.

Delay or denial of proposed actions

Moratorium on proposal until regional energy planning completed

If regional energy planning were initiated, involving state, federal, and local governments, the Kaiparowits power plant probably would be delayed two to three years.

Effects of delay

The Kaiparowits area would continue, without much change, the same industries and activities as it has in the past.

Denial of proposed actions

The participants would be forced to look to other areas and sources of energy and possibly a reduction in consumption of electricity in the market area. The Kaiparowits area would continue with the same industries and activities.

If the Kaiparowits Power Plant was denied, 102,000 acre-feet of water would be freed to be used in other power or chemical projects or for agricultural purposes.

The coal in the Kaiparowits area could be used for coal gasification and other related petro-chemicals.

INTRODUCTION

This chapter is organized as follows: First are technical alternatives or modifications of the project as proposed. The basic project remains unchanged. Second are alternative site locations. There range from Nipple Bench, which is close to the proposed site, to sites in other states. Next are different methods of meeting the same project objectives, such as using nuclear power to generate electricity. Finally the effects of delay or denial of the project is considered along with the subsequent alternate uses of water and coal.

TECHNICAL ALTERNATIVES

Generating plant designs

Site arrangement

The proposed site arrangement was arrived at by the participants, using construction and operating constraints as well as physical and environmental considerations. However, it is possible that changes in location of various components might occur during final design engineering. These changes would not increase total size or basic area required by each component.

Since total area impacted by each component would be about the same regardless of arrangement, impacts evaluated in Chapter III would be similar to alternative site arrangements on Fourmile Bench.

Power block

Stack lighting

One alternate stack marking scheme was evaluated against the proposed action of strobe lights during daylight hours and red warning lights at night. The other scheme was a 24-hour strobe light with reduced intensity during night-time hours. The strobe lights can be seen at greater distances at night than the red lights. This would create a greater visual impact during night-time hours.

Particulate and SO_2 removal systems

Introduction

Air pollution abatement systems required for Kaiparowits to meet environmental protection commitments are:

1) 99.5% particulate removal

2) 90.0% sulfur dioxide removal.

An extensive survey by Bechtel Power Corporation (Bechtel, 1974) for the participants, was made on particulate and SO_2 removal systems for meeting applicable government regulations regarding plume opacity and allowable emissions. Four particulate removal systems and seven sulfur dioxide removal systems were evaluated (see Figure 1). This evaluation resulted in selection of the proposed system, discussed in Chapter I (a hot electrostatic precipitator followed by a wet lime SO_2 scrubber).

Hot and cold electrostatic precipitators

If propoerly designed, both cold and hot precipitators can perform to Kaiparowits design criteria: i.e., 99.5% removal efficiency. The main difference is that the design of a cold precipitator for low sulfur coals, as found on the Kaiparowits Plateau, is very sensitive to changes in fly ash chemistry and electrical characteristics. Without this information on fly ash chemistry and electrical characteristics, the design of a cold precipitator is an uncertain operation and precipitator performance would be difficult to predict. The hot precipitator operates in the temperature range of 650-850° F, and performance is relatively insensitive to most of the uncertainties which could affect the cold precipitator. Consequently, more confidence in the efficiency and reliability of performance, greater flexibility in fuels variation, and ease of material handling can be expected from a hot precipitator for low sulfur coals.

FIGURE 1

Summary of Alternate Particulate and SO_2 Abatement System
(Sulfur Dioxide Removal System)

	Lime/Limestone	Double Alkali	Wellman-Lord	Magnesium Oxide	Catalytic Oxidation	Copper Oxide	Additive Injection
Meets Kaiparowits 99.5% Particulate Removal Design Criteria	*	*	no removal	no removal	no removal	no removal	Creates Particulate
Meets Kaiparowits 90% SO_2 Removal Design Criteria	Yes	Yes	Yes	Yes	Yes	Yes	No
Types of System	wet, non-regenerative	wet, non-regenerative	wet regenerative	wet regenerative	wet regenerative	Dry regenerative	dry non-regenerative
Chemicals Required Tons/Day	280 tpd lime (CaO)	100 tpd make up soda (Na_2CO_3) & lime (CaO)	50 tpd Na_2CO_3	20 tpd MgO	make-up V_2O_5 catalyst	make-up CuO catalyst	283 tpd lime (CaO) or 490 tpd limestone ($CaCO_3$)
Major Products & Wastes Produced Tons/Day	810 tpd $CaSO_4$, $CaSO_3$ & $CaCO_3$	720 tpd $CaSO_3$ & $CaCO_3$	70 tpd $MaSO_4$ pure in soln. 140 tpd sulfur	150 tpd sulfur; 20 tpd MgO	600 tpd 78% by wt. H_2SO_4	150 tpd sulfur	830 tpd $CaSO_3$, $CaSO_4$ & $CaCO_3$
Stages of Development	full scale	pilot plant	full scale demonstration	full scale demonstration	full scale demonstration	pilot plant	abandoned
Operational Reliability	good	not available	good	fair	poor	not yet available	poor

tpd - tons/day
* - has some removal

(continued)

FIGURE 1 (continued)

Summary of Alternate Particulate and SO_2 Abatement System
(Particulate Removal System)

	Hot Precipitator	Cold Precipitator	Baghouse	Venturi
Meets Kaiparowits 99.5% Particulate Removal Design Criteria	Yes	Yes	Yes	Yes
Meets Kaiparowits 90% SO_2 Removal Design	no removal	no removal	no removal	*
Types of System	Dry	Dry	Dry	Wet
Chemical Required Tons/Day	None	None	None	None
Major Products & Wastes Produced Tons/Day	1,820 tpd fly ash	1,820 tpd fly ash	1,820 tpd fly ash	1,820 tpd fly ash
Stages of Development	full scale	full scale	small (80 mw) Comercial scale	full scale
Operational Reliability	good	good	good	fair

tpd - tons/day
* - has some removal

Baghouse

Baghouses are simply porous fabric filter bags housed in a large structure. When dust-laden gases pass through these filters, particulate matter is collected by the bag fabric and then removed by a certain dust-dislodging step. The particulate removal capability of a baghouse can be expected to exceed 99.5%.

Advantages of baghouses are that filters can be operated under a wide range of load conditions, maintenance can be performed while in operation without disturbing filtration efficiency, and high collective efficiency for sub-micron particulates. Main disadvantages are bulky construction and large space requirement, moisture limitation (the gas temperature must be above its dew point at all times to avoid moisture condensation), no large scale coal-fired generating station experience available, and possible bag rupture which would create injurious health problems to employees and allow considerable fly ash to escape into the atmosphere. Other than the disadvantages just listed the impacts of a baghouse to the air quality would not differ from the impacts of a hot precipitator.

Venturi scrubbers

A venturi scrubber for particulate removal is a high energy wet scrubber. The flue gas and liquid are accelerated through the venturi throat, causing atomization of the scrubber liquid. Fast-moving solid particles penetrate into the water droplets and become wetted and agglomerated. Finally, they are removed in the form of a slurry.

Removal efficiency of a venturi scrubber is determined by particle size and pressure drops over the scrubber system. To obtain a removal efficiency of 99.5 percent at Kaiparowits, a pressure drop of 20 inches (water gauge) or higher may be needed.

Compared to electrostatic precipitators and baghouses, venturi scrubbers require less space. Fly ash would be removed in the form of a slurry. More power

would also be needed for operation due to the high pressure drop requirement. The disadvantages of this alternative would be greater fuel consumption in order to maintain the high pressure drop requirements and greater water consumption for the slurry. The Bechtel Power Corporation study does not qualify the increase in fuel and water consumption. The study only states that more electrical power and water are needed and it is less reliable than a hot precipitator. The unit is not any more efficient in removing paritculates than the proposal (Bechtel, 1974).

Sulfur dioxide removal systems

Many SO_2 removal processes are under development. U.S. processes that are most developed are lime/limestone, double alkali, Wellman-Lord, magnesium oxide, catalytic oxidation and copper oxide. Foreign processes have not been included because sufficient data are not available.

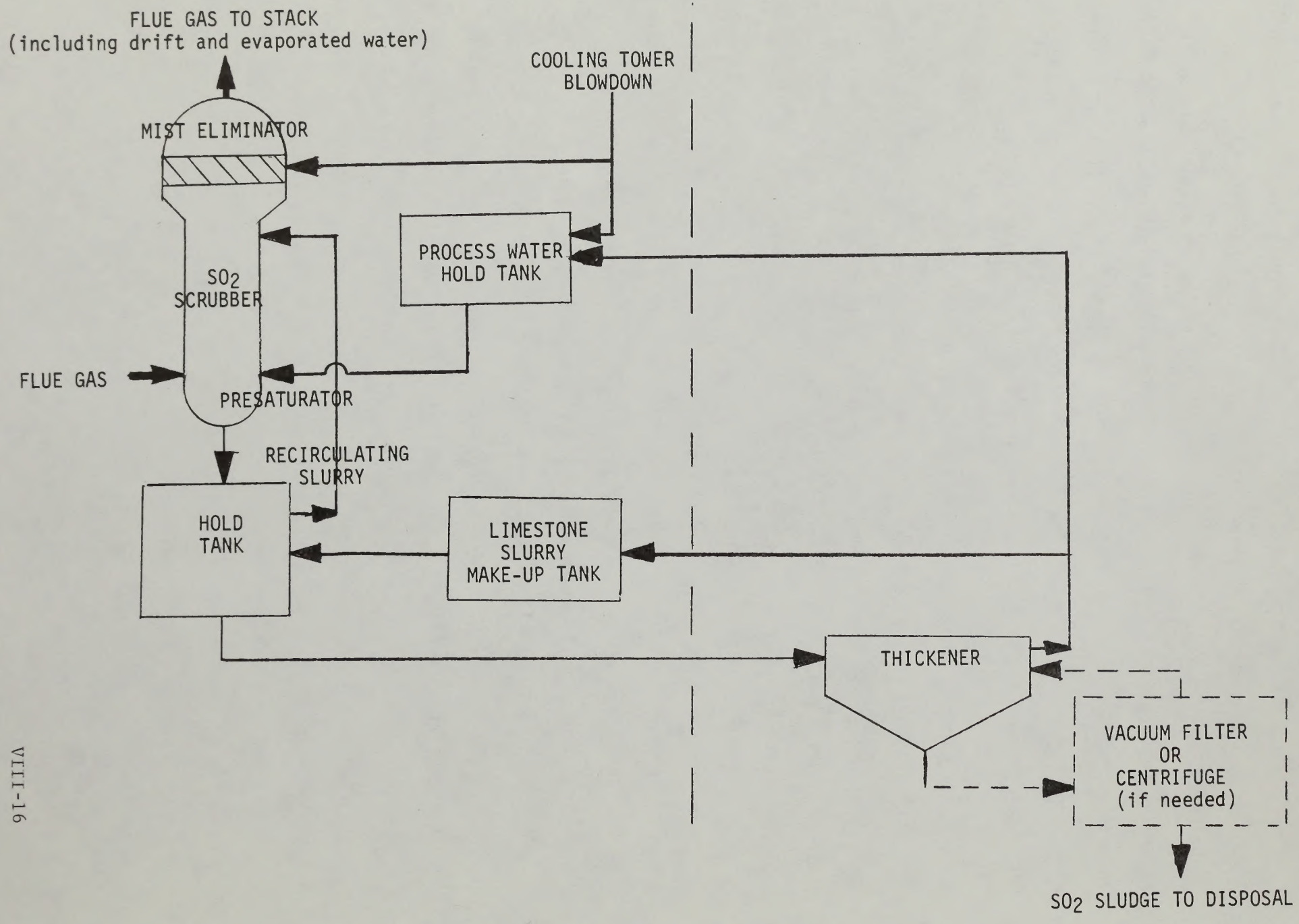
Limestone processes

The wet limestone scrubber process is a non-regenerative process which uses limestone ($CaCO_3$) as a chemical additive to remove SO_2 content from the flue gas stream Overall reactions for limestone scrubbing are repreentied as follows:

$$CaCO_3 + SO_2 + 1/2H_2O \longrightarrow CaSO_3 \quad 1/2H_2O + CO_2$$

In the limestone scrubbing system, flue gas enters the scrubber where the gas/liquid contact necessary for the chemical reaction occurs (see Illustration 1). The flue gas, with most SO_2 removed, emerges from the absorption section of the scrubber with some entrained slurry and passes through a mist eliminator. Purpose of the mist eliminator is to reduce mist and drift. Drift is entrained slurry.

Based on experience to date, both limestone and lime systems are expected to be capable of removing up to 90 percent of SO_2 from flue gases. Major advantages of the lime/limestone system are successful operation of full scale units over extended periods of time and capability of removing both particulates and SO_2.



TYPICAL LIMESTONE PROCESS FLOW DIAGRAM

ILLUSTRATION

Both lime and limestone are expected to give acceptable performance in the proposed SO_2 removal system. Use of lime is proposed by the participants because a full-scale module test at Mohave, by participants, demonstrated that lime can meet the Kaiparowits SO_2 removal efficiency and design criteria. Before September, 1974 the limestone system had not been tested at Mohave. The limestone system would eliminate need for a kiln, associated baghouses, extra coal handling equipment, blowers, and 70 tons/day of coal for use in the kiln.

Double alkali process

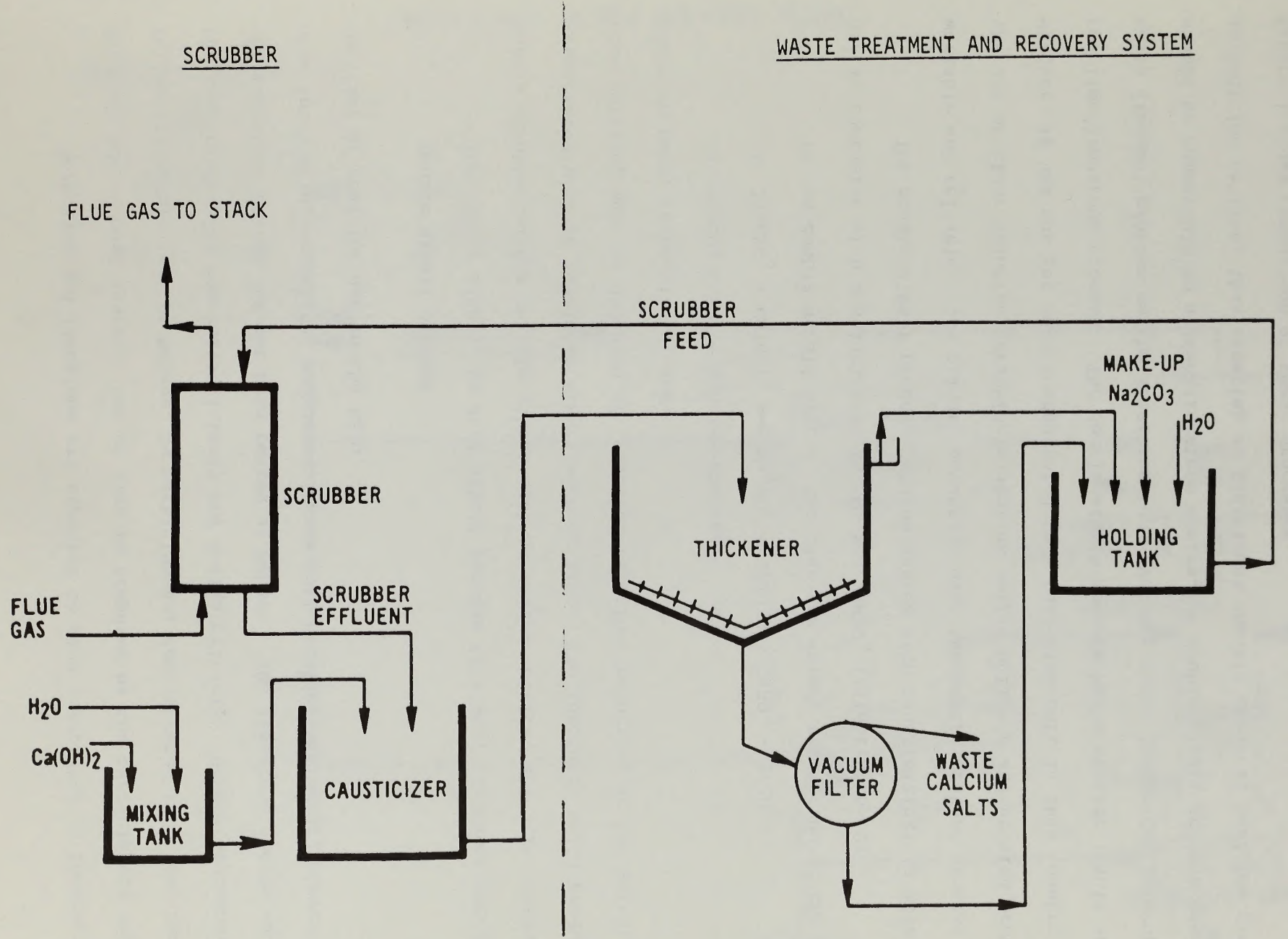
The double alkali, or dual alkali process is a wet, throwaway process. Flue gas is scrubbed with a soluble alkali such as sodium sulfite, which is subsequently regenerated with an insoluble alkali such as lime. The insoluble solid produced, calcium sulfite, must be disposed of. Typical reactions occurring in the scrubber and reaction tank, respectively, are:

1) $Na_2SO_3 + SO2 + H_2O \rightarrow 2NaHSO_3$

2) $2NaHSO_3 + Ca(OH)_2 \rightarrow Na_2SO_3 + 3/2H_2O + CaSO_3 - 1/2H_2O$

In one double alkali system, the flue gas enters the bottom of the scrubber and is contacted with a solution of Na_2SO_3 and $NaHSO_3$ (Illustration 2).

The double alkali process (sodium system with causticizing) is potentially workable and reliable. Its primary advantage over the lime/limestone process is that the use of clear solution scrubbing minimizes solids build-up and erosion problems. However, it has not yet been domonstrated in a full-size unit in this country as has the lime/limestone process. The double alkali process has a similar liquid and solid waste disposal problem as the lime/limestone system. Water losses due to evaporation should be comparable to a lime/limestone system. A double alkali process uses soda in addition to lime, thus creating an additional caustic chemical handling problem. Figure 1 shows comparison of these processes.



DOUBLE ALKALI PROCESS FLOW DIAGRAM - SODIUM SCRUBBING WITH LIME REGENERATION

ILLUSTRATION 2

Wellman-Lord process

The Wellman-Lord SO_2 recovery process is a wet regenerative process which utilizes a sodium sulfite-sodium bisulfite solution to absorb SO_2 from flue gas. The spent absorbent, rich in bisulfite, is processed in a steam-heated evaporator regenerating active sodium sulfite crystals and producing a concentrated stream of SO_2 for further processing (illustration 3). The simplified process chemistry is:

Absorption by Sodium Scrubbing

$$SO_2 + Na_2SO_3 + H_2O \rightarrow 2NaHSO_3$$

Thermal Regeneration

$$2NaHSO_3 \rightarrow Na_2SO_3 + SO_2 + H_2O + \text{heat}$$

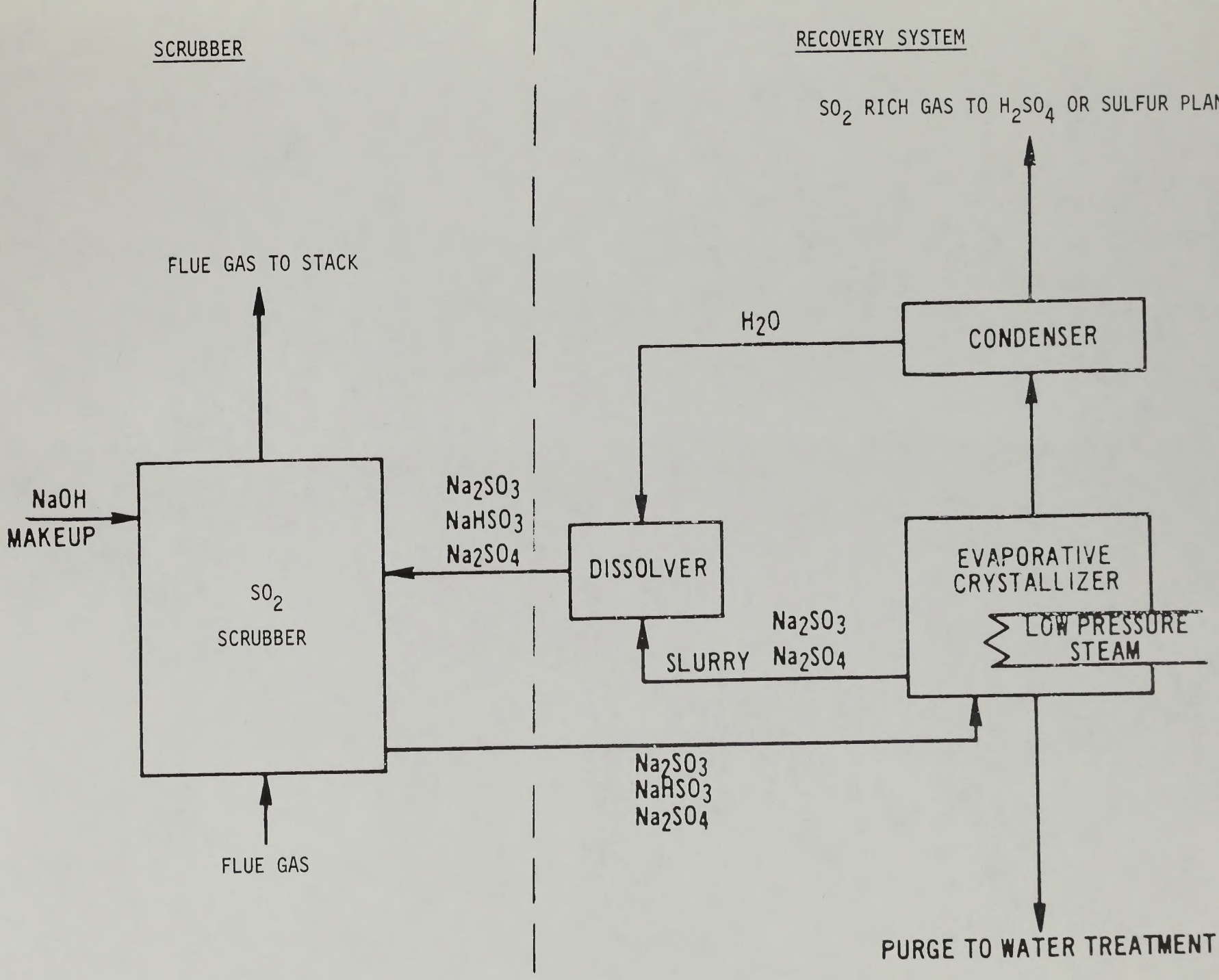
The vapor product is cooled to condense the water. The pure gaseous SO_2 can be further processed in a suitable acid/chemical plant to elemental sulfur or H_2SO_4. Condensed water is used to redissolve the sulfite solids for recycle to the scrubber.

Of the regenerative SO_2 removal systems presently available, the Wellman-Lord sodium sulfite scrubbing process has operated most reliably. The process has demonstrated the ability, on oil-fired boilers, to remove 90 percent of the SO_2 from higher inlet SO_2 concentrations than expected at Kaiparowits. Elemental sulfur or high grade sulfuric acid can be produced, although ability to market these materials near Kaiparowits is unknown.

Major disadvantages are: the need to sell or dispose of a purge stream containing sodium sulfate and other sodium salts, increase of three to six percent in energy demands from the power station, necessity of a chemical regeneration plant, and lack of coal-fired application experience.

Magnesium oxide process

The magnesium oxide process is a wet regenerative process which uses a slurry containing magnesium oxide (MgO), magnesium sulfite ($MgSO_3$) and magnesium



WELLMAN-LORD PROCESS FLOW DIAGRAM

ILLUSTRATION 3

sulfate ($MgSO_4$) to remove sulfur dioxide. The SO_2 that is removed can be converted to 90 percent $H2SO_4$ or elemental sulfur by a suitable acid/chemical plant.

In the process offered by the Chemical Construction Company, flue gas containing SO_2 and SO_3 enters a venturi absorber and contacts the absorbing medium (Illustration 4). SO_2 in the flue gas diffuses through the gas to the liquid and reacts with hydrated MgO.

$$MgO + SO_2 \rightarrow MgSO_3$$

Major advantages of the MgO process are summarized as follows:

1) Sulfur can be recovered as high grade acid or elemental sulfur.

2) Regeneration can be accomplished at a location quite distant from the power plant, thus permitting use of a central regeneration facility serving several flue gas cleaning locations.

3) Ninety percent removal can be obtained, with a high turndown capability.

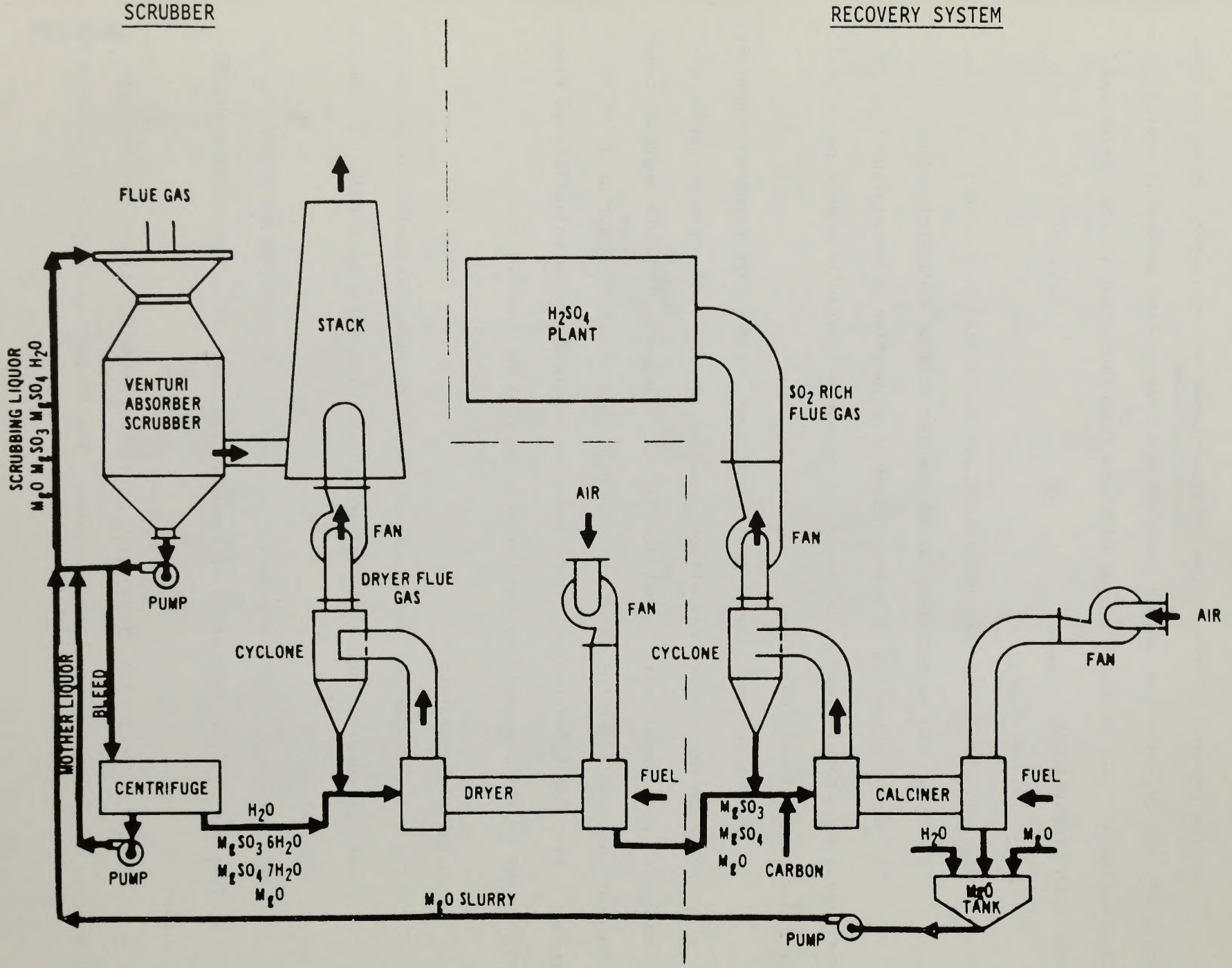
Although the MgO process offers many advantages, long-term operating experience with coal-fired units is not available. Energy requirements would increase because of fuel needs for the dryer and calciner in addition to power needs of the scrubber. Also, an acid/chemical plant would be required and marketability of elemental sulfur or sulfuric acid in the Kaiparowits area is unknown.

Catalytic oxidation

The catalytic oxidation process developed by Monsanto Environ-Chem Systems, Inc. is a wet regenerative process resulting in the production of a weak (78% concentration) sulfuric acid.

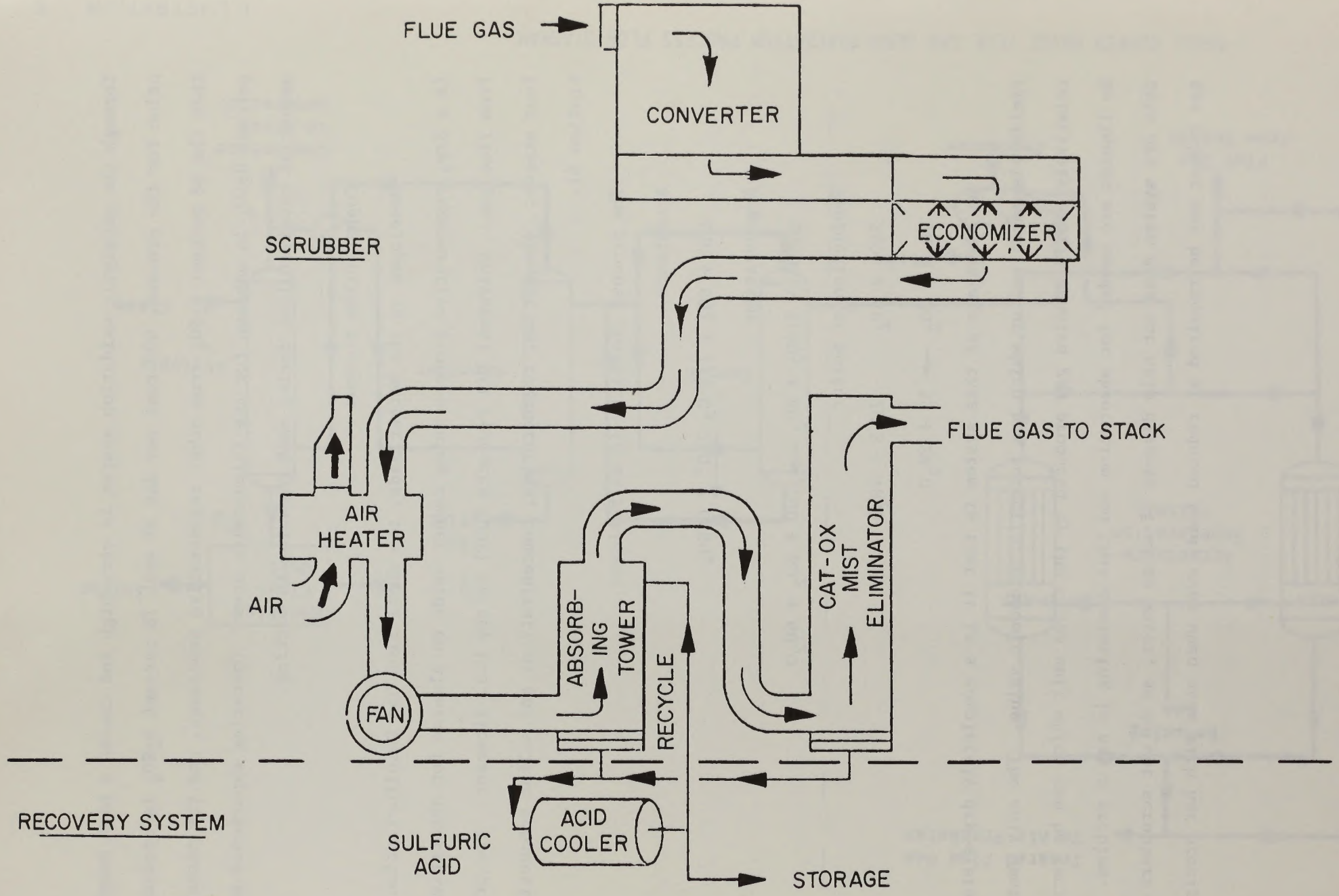
The chemical process occurs in two steps: the oxidation of SO_2 to SO_3 in the catalyst bed and the absorption of the SO_3 by a sulfuric acid scrubbing liquid (Illustration 5).

Although the reliability of the catalytic oxidation system may be high, the process is presently not a proven system. The 42-inch water gauge pressure drop



MAGNESIUM OXIDE SLURRY PROCESS FLOW DIAGRAM - WITH DRYER FLUE GAS RELEASED TO STACK

ILLUSTRATION 4



CATALYTIC OXIDATION PROCESS FLOW DIAGRAM

ILLUSTRATION 5

through the catalytic oxidation system is very high and causes a high energy consumption for the process, 600 tons per day of weak 78 percent H_2SO_4 is produced rather than the 98 percent H_2SO_4 from other regenerative processes, and the market for 78 percent H_2SO_4 is unknown for the Kaiparowits area. Operating experience such as the amount of catalyst lost during each cleaning is lacking.

Copper oxide process

Developed in the Netherlands, the Shell Flue Gas Desulfurization Process is a dry, regenerative process using copper oxide on alumina for absorption of SO_2 from flue gas. Universal Oil Products (UOP) is the U.S. licensor. The process has four stages: absorption, regeneration, concentration, and sulfur production (Illustration 6).

The process chemistry is as follows:

Acceptance

$$CuO + SO2 + 1/2\ O_2 \xrightarrow{750°\ F} CuSO_4$$

Regeneration

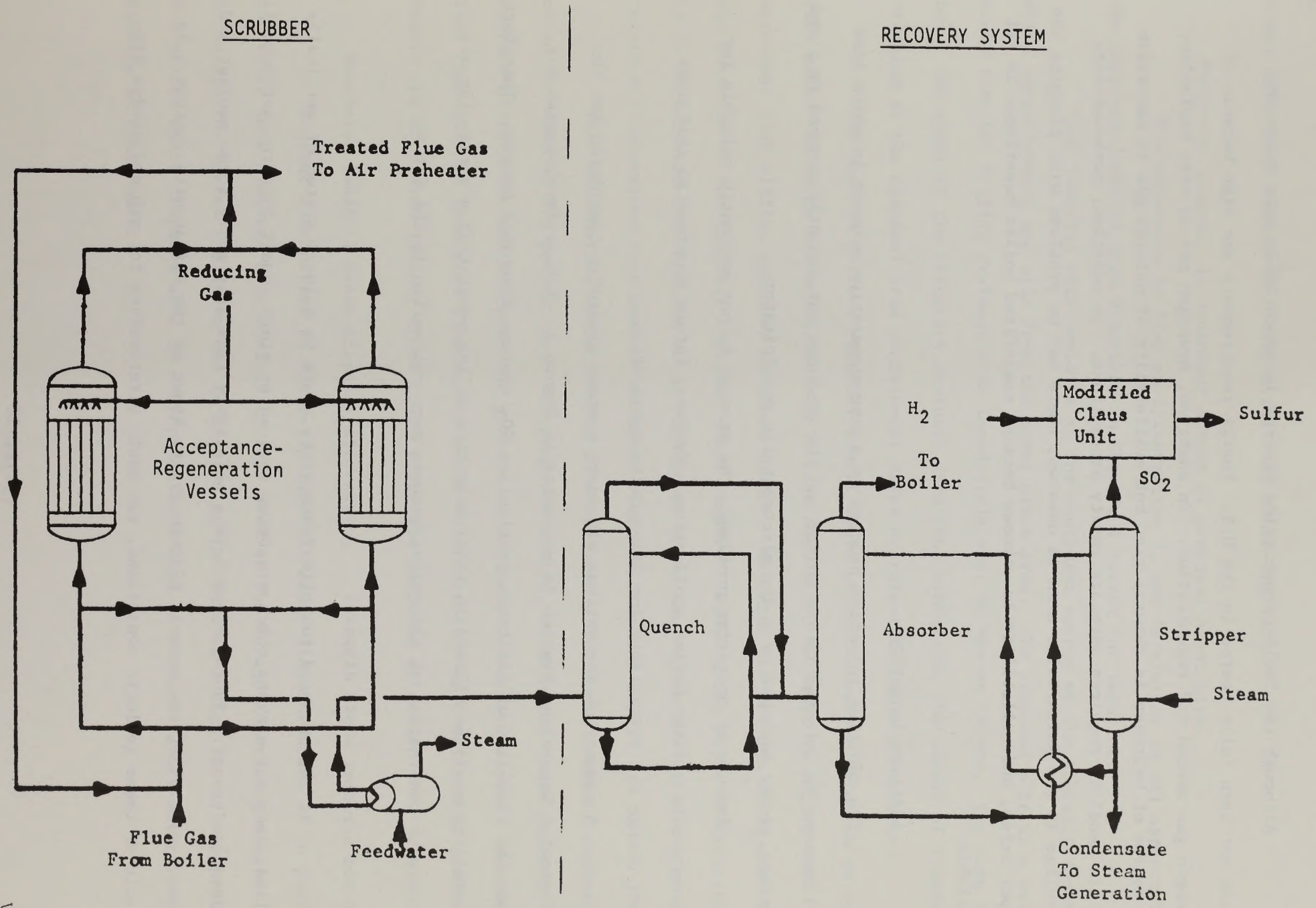
$$CuSO4 + 5/2O_2 + 6H_2 \rightarrow CuO + SO_2 + 6H_2O$$

Production of Sulfur

$$2SO_2 + 6H_2 \qquad 2H_2S + 4H_2O$$

$$2H_2S + SO_2 \rightarrow 3S + 2H_2O$$

An advantage of this system is that it is a completely dry system and yields elemental sulfur which has potential economic value. The only waste is a relatively easily handled gas produced by the Claus unit which can be recycled. No liquids are needed for absorption and thus demisting is not a problem. However, this dry system does not help dispose of waste water, as do wet scrubbers. Flue gas reheat may be required at reduced load, even when used with hot precipitators.



SHELL COPPER OXIDE FLUE GAS DESULFURIZATION PROCESS FLOW DIAGRAM

ILLUSTRATION 6

Although the Shell copper oxide process is potentially very promising, it has not been fully tested in the U.S. Energy requirements are high because of hydrogen gas needed for regeneration. In addition, hydrogen gas is very explosive. One source of hydrogen is natural gas, but availability of natural gas is uncertain and its handling requires adequate safety precautions. In addition, marketability of sulfur in the Kaiparowits area is unknown; there may be problems with plugging the copper oxide, and reliability is unknown because coal-fired boiler experience is not available.

Additive injection

The additive injection process is a nonregenerative process in which lime or limestone is injected into a boiler and the products subsequently removed by a wet scrubber, a dry baghouse or a dry electrostatic precipitator.

Because of operating problems, the process is not presently suitable for a large-scale utility boiler application. However, future progress in this area might change its suitability for Kaiparowits application.

A summary of the various alternate systems presently considered for the Kaiparowits Generating Station is presented in Figure 1. Future developments may alter the viability of alternate particulate SO_2 systems discussed herein. Therefore flexibility would be allowed in final selection in the event that a particular alternate or combination of alternates becomes more attractive in the future.

Ash and scrubber waste disposal

At the proposed Fourmile Bench site, there is a local system of vertically walled, deep cut canyons which are being incised by storm runoff into the horizontally bedded sandstones. Fourmile Bench is a relatively flat area above these canyons and forms a portion of the overall plateau system known as the Kaiparowits Plateau. As a result of these geologic conditions, two basic alternatives for ash and sludge dis-

posal have been considered - canyon fill and bench-top fill.

Bench-top landfill in southeast corner of proposed plant site

This alternate is II-B on Illustration 7, and is similar in all aspects to the proposed landfill area described in Chapter I except for location.

This landfill site would be in the southeast corner of the Fourmile Bench site, approximately one mile from the power block area. The proposed site is a relatively flat but rolling drainage area immediately west of Wesses Canyon. The site would be at the crest of the tributary drainage area thus minimizing the amount of floodwater drainage to the disposal area containment dikes or retention basin structures.

The pond to collect rainfall runoff would be approximately 49 acres in surface area. An earth dam approximately 35 feet high would be built to retain 430 acre-feet (140 million gallons) of storm runoff. Material for the dam would come from the interior of the landfill site and would require 171,000 cubic yards of excavation. It is anticipated that the dam would consist of dense sandstones for ballast with a relatively impervious core made of mudstone from the disposal area.

This alternative would require an additional 4,000 cubic yards of excavation, or an increase of 2.3 percent over the proposed action, which might cause greater surface disturbance and increase the problem of sediment in surface waters. However, less than half of this site (230 acres) would be affected by salt drift from cooling towers and no pinyon-juniper trees 1,400 years old would be affected.

Bench-top landfill waste disposal alternative

Another alternative to bench-top landfill waste disposal would be to place the waste in a disposal area similar to that used at the Navajo Generating Station. At Navajo the wastes are deposited in an area at the base of a high bluff. Downstream end of the waste disposal area is surrounded by a berm to prevent runoff water from flowing to Lake Powell.

Wastes are placed and compacted adjacent to the berm and are spread evenly over the area to produce an engineered fill behind the berm.

This alternative would be similar to the proposed bench-top fill except that a dam and runoff evaporation pond would not be used. Placement and compaction of the solid wastes would result in rainfall runoff being contained on the compacted solid waste mixture.

This alternative would require less construction work due to absence of the dam and runoff evaporation pond. However, there are no high bluffs within the proposed plant site boundaries and disposal of this type would create a large mound of waste which would expose more surface area to the climate elements thus increasing the possibility of more rapid erosion and pollution of Warm Creek drainage and Lake Powell. Also it would be more readily visible than an excavated landfill.

Canyon landfill in west branch of John Henry Canyon

This is alternate I in Illustration 7 and would be basically the same operation as bench-top fill. It would consist of placing waste in the west branch of John Henry Canyon, spreading it, compacting it, covering it with one foot of earth, and sloping the waste pile to a runoff collection pond at the downstream end of the canyon. Use of the east branch of John Henry Canyon for a fill site was eliminated due to a greater degree of irregularity in the canyon walls and more difficult access.

In order to retain 450 acre-feet of storm runoff, a pond (approximate size and location shown in Illustration 7 would need to be constructed with a surface area of 41 acres. An earth dam approximately 200 feet high would be built from dense sandstones excavated in the reservoir area. Material for the core would come from mudstones located in the northern part of the plant site.

In order to construct the dam and fill the canyon, a haul road would be constructed from the power block area to the floor of the canyon. Earthwork for

N 840,000

N 838,000

E 1,954,000

E 1,948,000

E 1,940,000

BENCH TOP FILL
ALTERNATE 8A

BENCH TOP FILL
ALTERNATE 8B

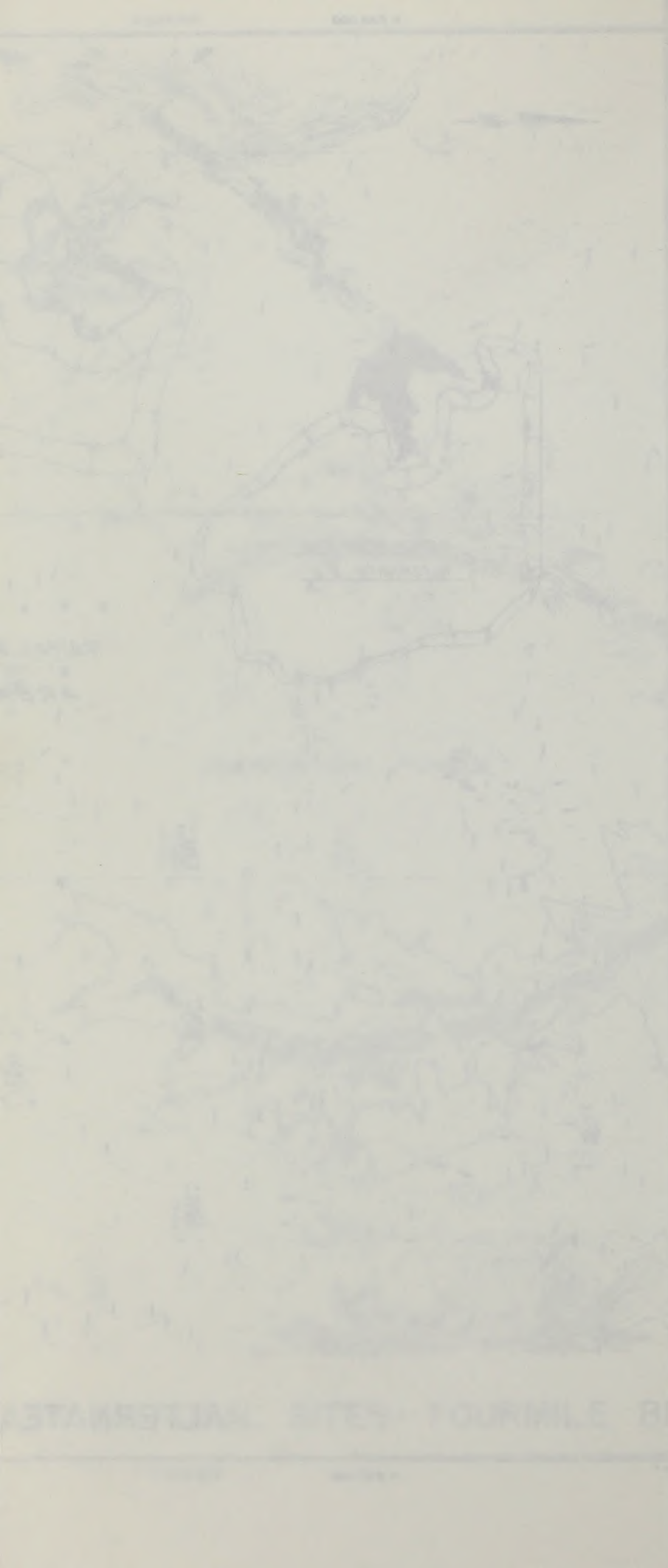
MAIN PLANT
AREA

EVAPORATION PONDS

800 0 800 1600 2400
SCALE IN FEET

ALTERNATE ASH DISPOSAL SITES – FOURMILE BENCH

ILLUSTRATION 7



this road would require approximately 269,000 cubic yards of cut and 114,000 cubic yards of fill. Majority of the work would be cutting, which would entail a large amount of blasting. Exact amount is not yet known due to lack of subsurface exploration. However, blasting would be estimated to be between 25 and 50 percent above the 6,000-foot elevation and almost 100 percent below that elevation.

From the power block area to the floor of the canyon, the road would be surfaced with a road-mixed asphalt material. Spur roads running over the fill would be treated with a cementing agent. The haul road would support 85-ton dump trucks at speeds up to 50 miles per hour. Maximum grade no greater than 10 percent would occur in the run down the canyon walls.

It might be feasible to surface the haul road with ash which, if compacted properly, could attain high bearing capacity. This would be determined prior to final design of haul roads and would become practical only after the plant was in operation and producing ash.

Access into the canyon would require additional construction and blasting, with possible damage to the geologic formation. This alternative would result in burial of all natural features of the canyon in an area two miles long and 1/2 mile wide. This method of landfill would not be as visible from the surrounding area as would the other bench-top landfill alternatives.

Diversion of the runoff from the plateau would be necessary to prevent erosion problems over the ash. Diversion ditches would have to be cut around the canyon fill area, and the water directed into lower parts of the canyon. This disruption of natural drainage flow would disturb approximately 10 more acres of vegetation and increase sediment to flow into Lake Powell by 0.01 acre/feet per year. To attain surface area required for evaporation of storm runoff from the disposal area, a large area of the canyon would be required. Also the probability of revegetation would be less than three years out of 10 due to shallow soils and rocky material.

Alternative to landfill - coal mine disposal

An alternative to landfill disposal is injection of the ash into the coal mine. This would be accomplished by slurrying the ash and pumping it through pipelines to mine injection points. The ash would be introduced into mine settling ponds through bore holes, dewatered, and allowed to set up as structural fill in excavated portions of the mine.

This alternative would require approximately 675 acre-feet of additional water per year to produce the slurry necessary for transport to the mine; this is an increase of 1.5 percent over present water use estimates.

The possibility of ground water contamination by trace elements and other compounds such as sulfates, sulfites and phosphates would become greater as water from slurried ash infiltrates through rock strata in the mine. Also, space would not be available in the mine for at least 10 years and some method of landfill would be needed during this time.

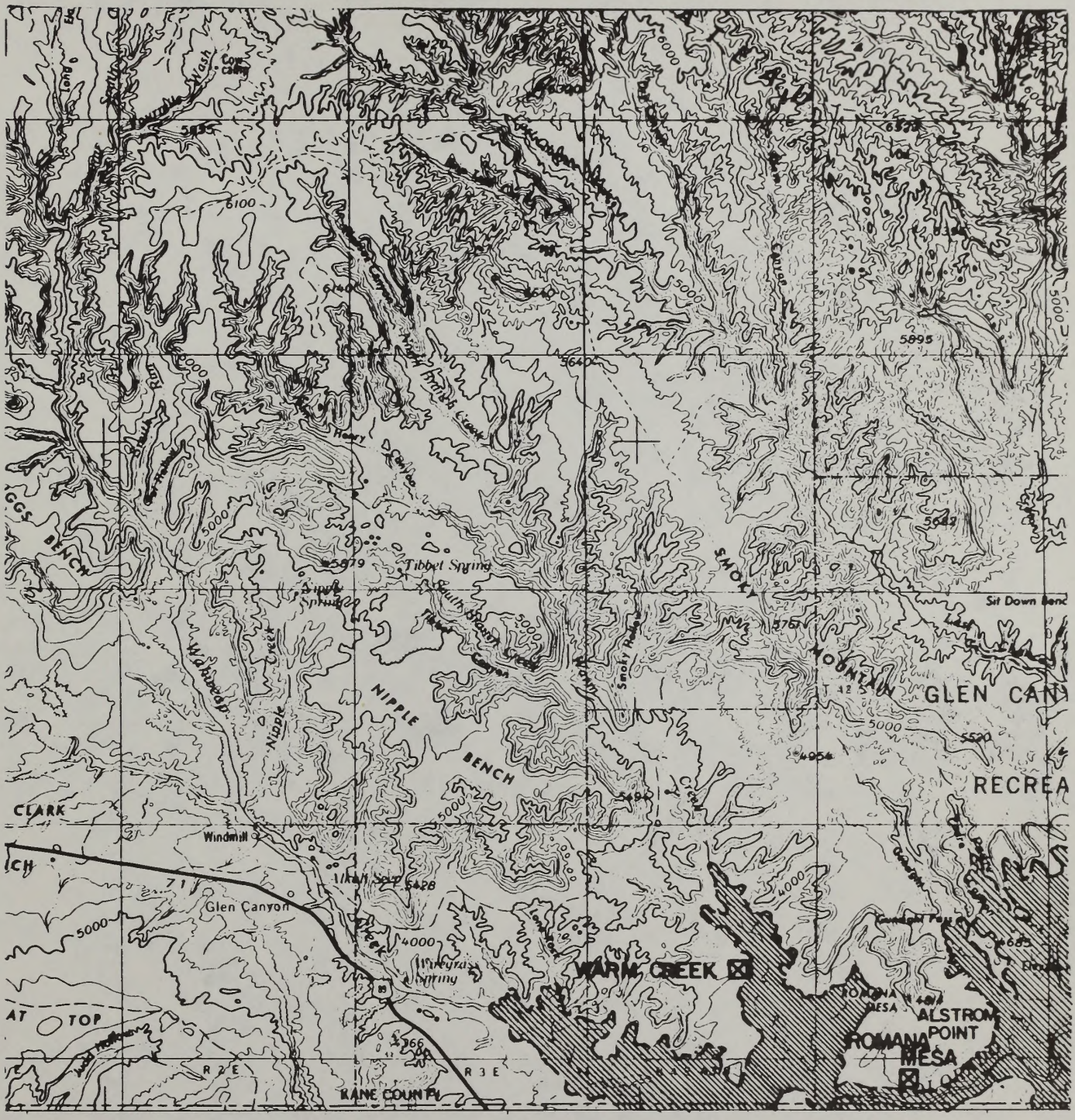
Based on present information it is impossible to predict when, where and if these pollutants would re-appear in springs or other surface waters. Also if the pollutants do appear it is not known what the adverse effects would be on wildlife, livestock, aquatic life in Lake Powell, and man.

Water supply system and storage

Romana Mesa Alternative

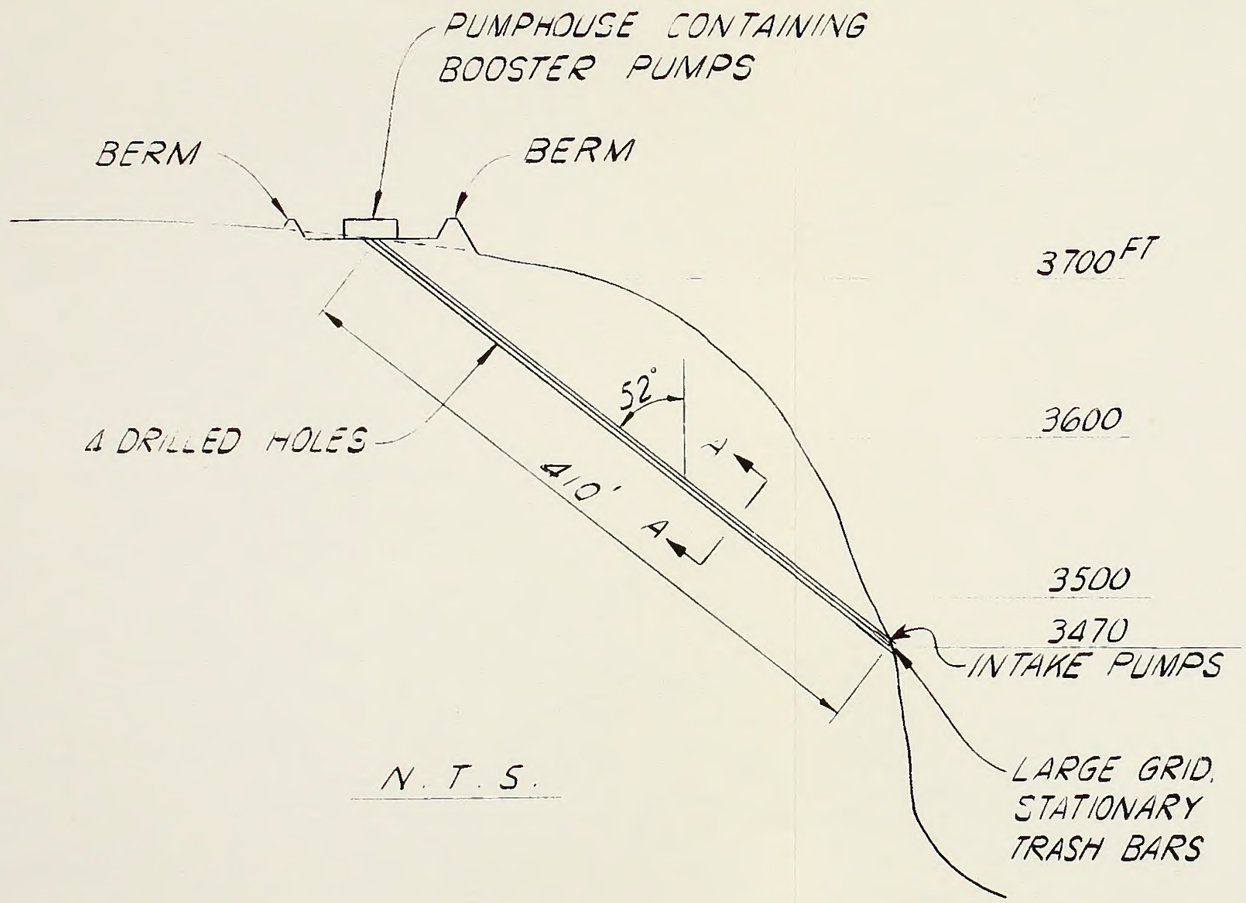
An alternate to the proposed tunnel/shaft intake at Warm Creek would be a site on Romana Mesa near Alstrom Point next to the mainstream of the Colorado River (see Illustration 8). At this location, four slanted shafts would be drilled and pumps installed as shown in Illustration 9. The pumps would discharge into a series of booster pumps similar to the system at Warm Creek. Because steep cliffs block inland access, personnel and equipment access to this site would be by boat/barge from the south side of the lake.

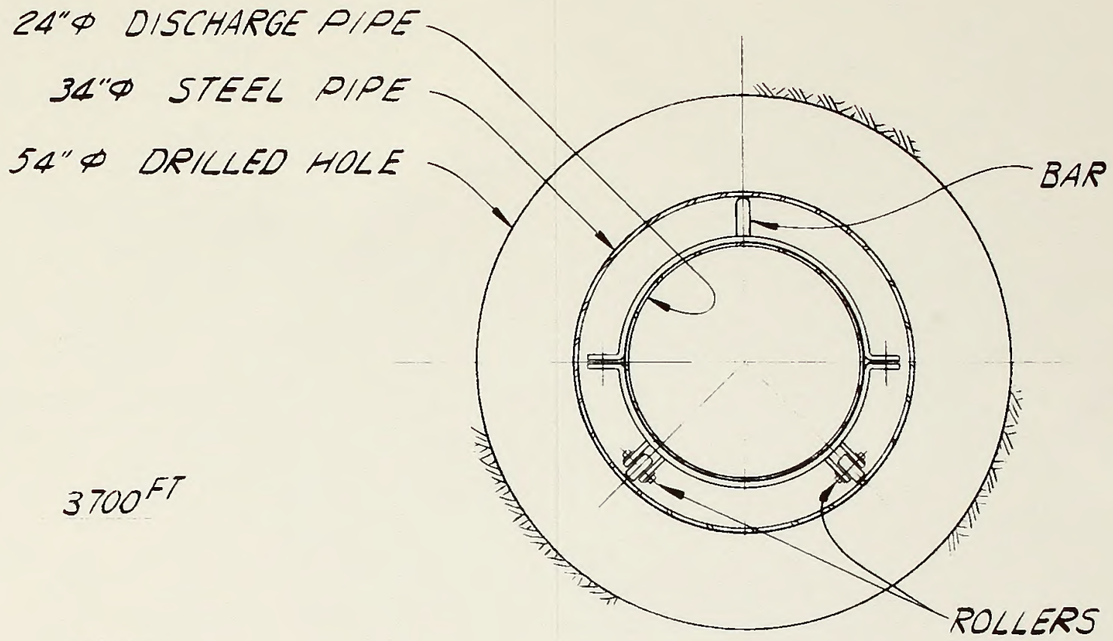
Above-ground building would be similar to that for Warm Creek and placed



ALTERNATE INTAKE LOCATIONS

ILLUSTRATION 8



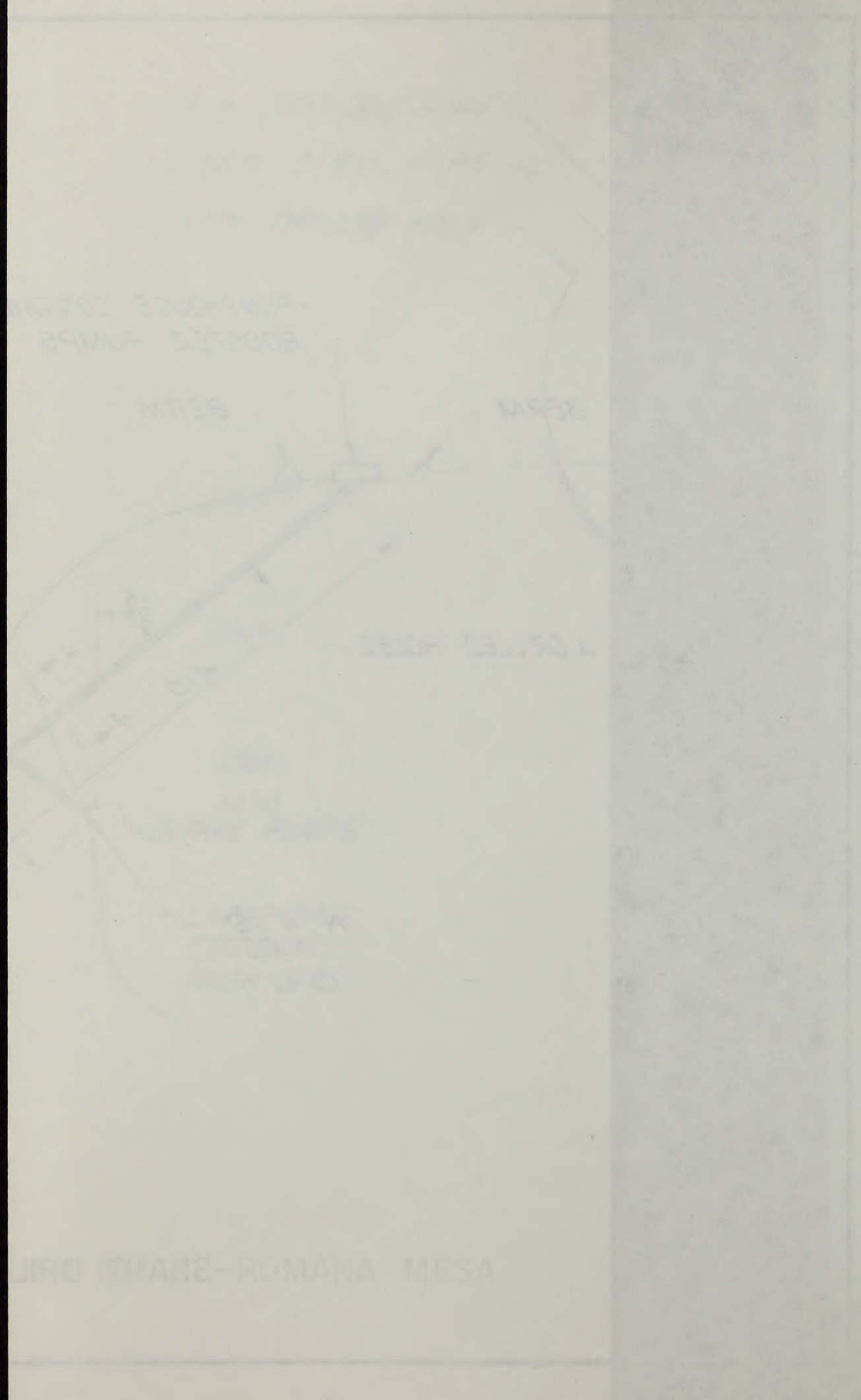


SECTION A-A

N. T. S.

SLANT DRILLED INTAKE-ROMANA MESA

ILLUSTRATION 9



over the drilled shafts. The drilling would not disturb any more area than the building would occupy.

The pipeline route from this intake would be approximately ten miles longer than the proposed route and would disturb approximately 27 more acres. With the pump intake at this location in the mainstream of the river channel, more people would pass this area and the visual impact would be greater. Since the intake depth of this alternative would be approximately the same as the proposed intake depth, the aquatic impacts evaluated in Chapter III would be the same for this alternate. The problems with surface rehabilitation would become greater due to low rainfall and clayey soils.

Warm Creek alternate

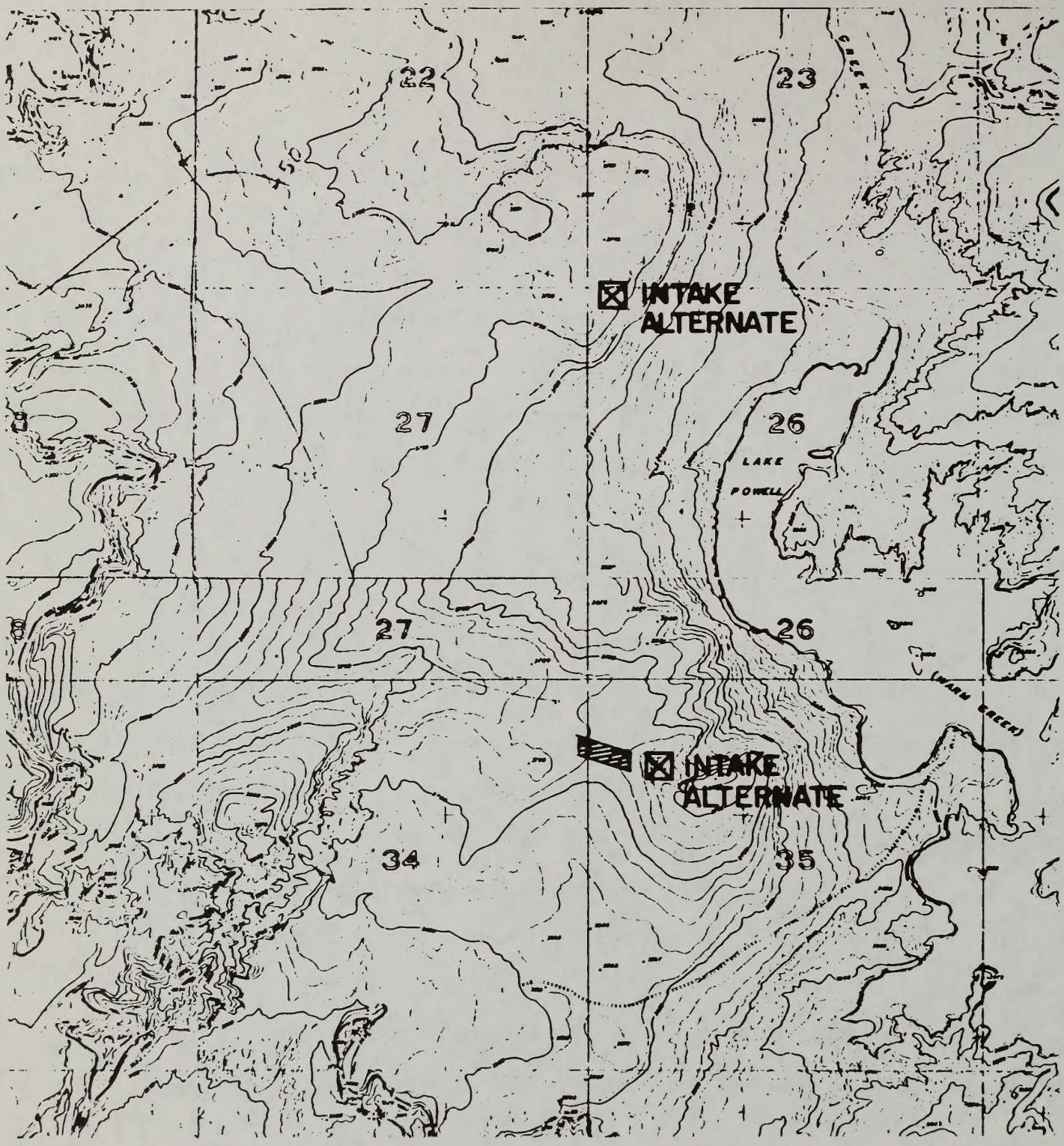
Warm Creek itself has two alternate locations within one mile of each other in Township 43 South, Range 4 East (Illustration 10). Future geotechnical engineering data will confirm whether the intake would be constructed at the proposed location in the northwest corner of Section 35 or at the alternate site at the intersection of Sections 22, 23, 26, and 27. Other factors affecting the decision would be pipeline length, water depth, tunnel length and soil conditions.

Impacts of this alternative would be the same as assessed for the proposed action in Chapter III.

In addition to the two types of intakes already discussed--tunnel/shaft and slant drill--a number of other intakes were investigated.

Trench Intake

This alternative (Illustration 11) would involve burying four straight conduits in the lake bottom. Similar to the slant drilled scheme, a pump and discharge pipe would be installed inside each conduit. The pumps would discharge into a series of booster pumps similar to the tunnel/shaft intake. The conduit must be installed perfectly straight so the submersible pump can be pulled through it for

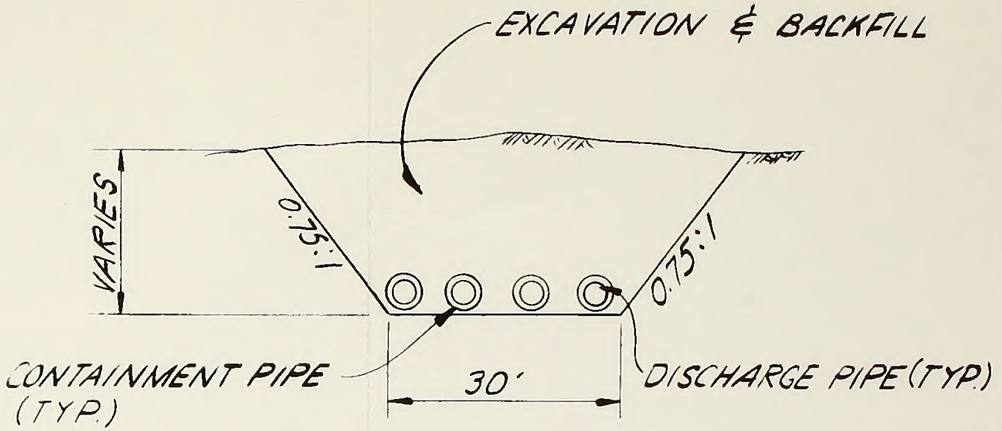


WARM CREEK INTAKE LOCATIONS

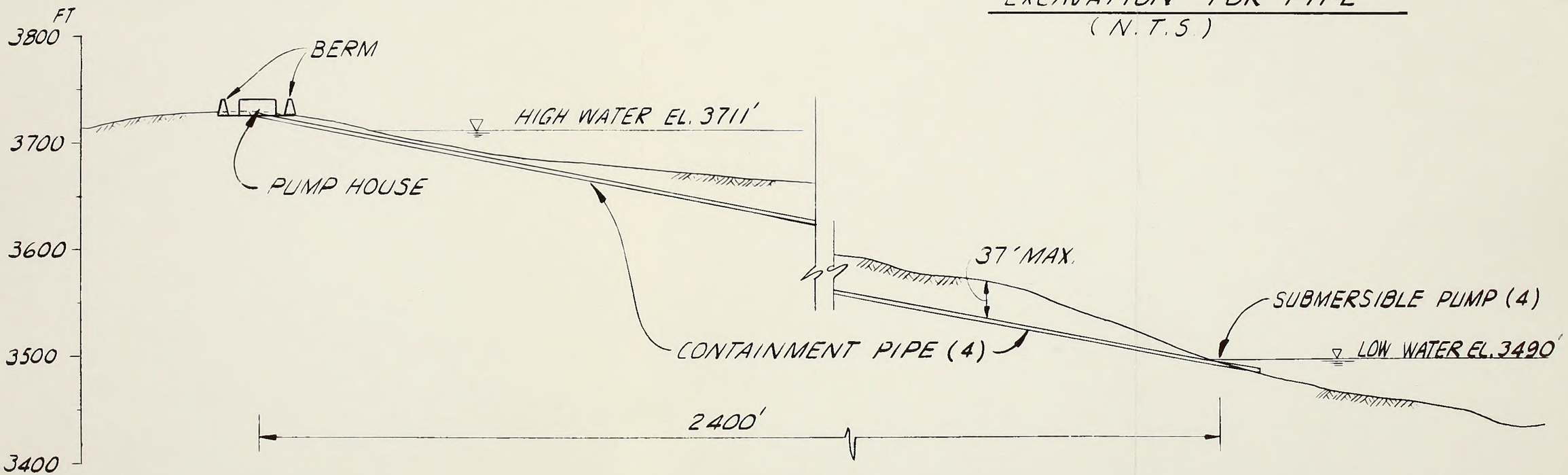
LEGEND

CAUSEWAY

ILLUSTRATION 10



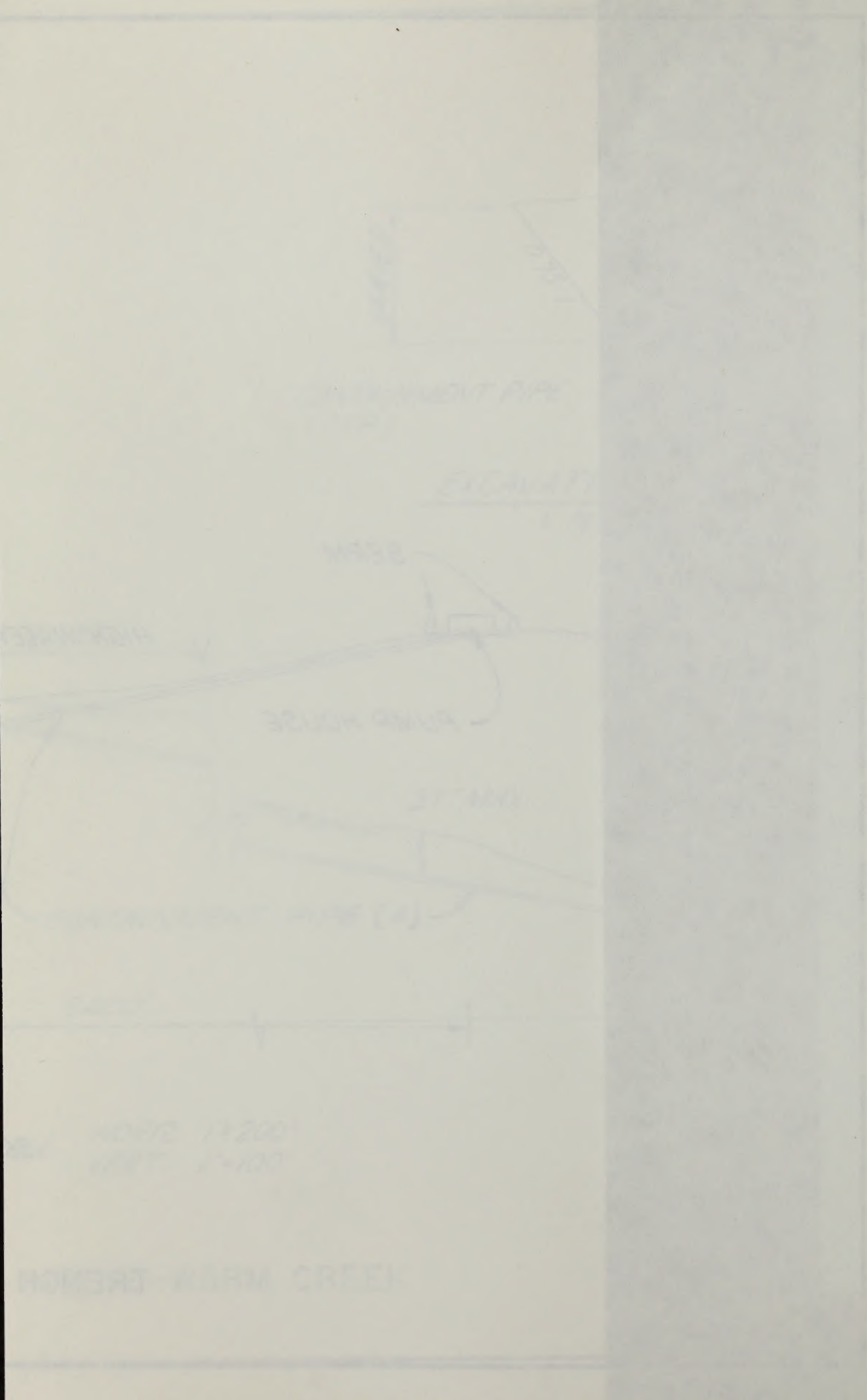
EXCAVATION FOR PIPE
(N.T.S.)



SCALE HORIZ 1"=200'
VERT. 1"=100'

TRENCH INTAKE–WARM CREEK

ILLUSTRATION 11



pump maintenance. Underwater blasting and construction would be difficult and disruptive to natural lake conditions during the construction period.

The above-ground building would be similar to that for the proposed intake. Underwater blasting would be destructive to aquatic organisms within the immediate blasting area. Blasting and construction would increase the silt load in the area and could be injurious to spawning fish.

The rising lake elevation has created unstable banks in some areas and blasting could cause some of these banks to slough off into the deep water-filled canyons. This could be hazardous to boaters and aquatic life in the immediate area.

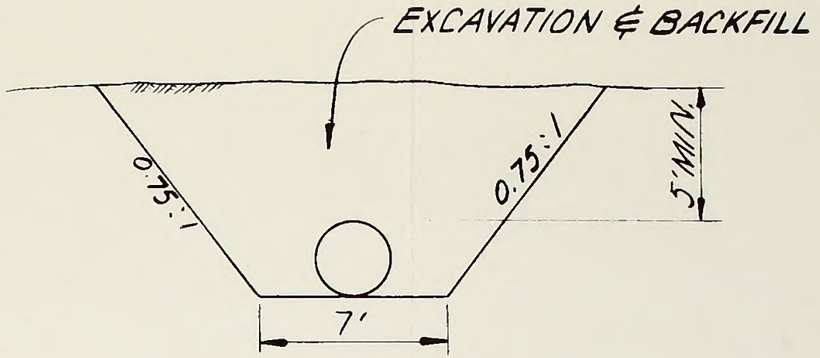
Jack-up offshore platform

As the lake elevation changes, an intake pump platform would be raised or lowered with jacks (Illustration 12). As the platform is lowered, the piles would extend out of the water, as high as 250 feet at low water, resulting in an adverse visual impact and a navigation hazard to boaters.

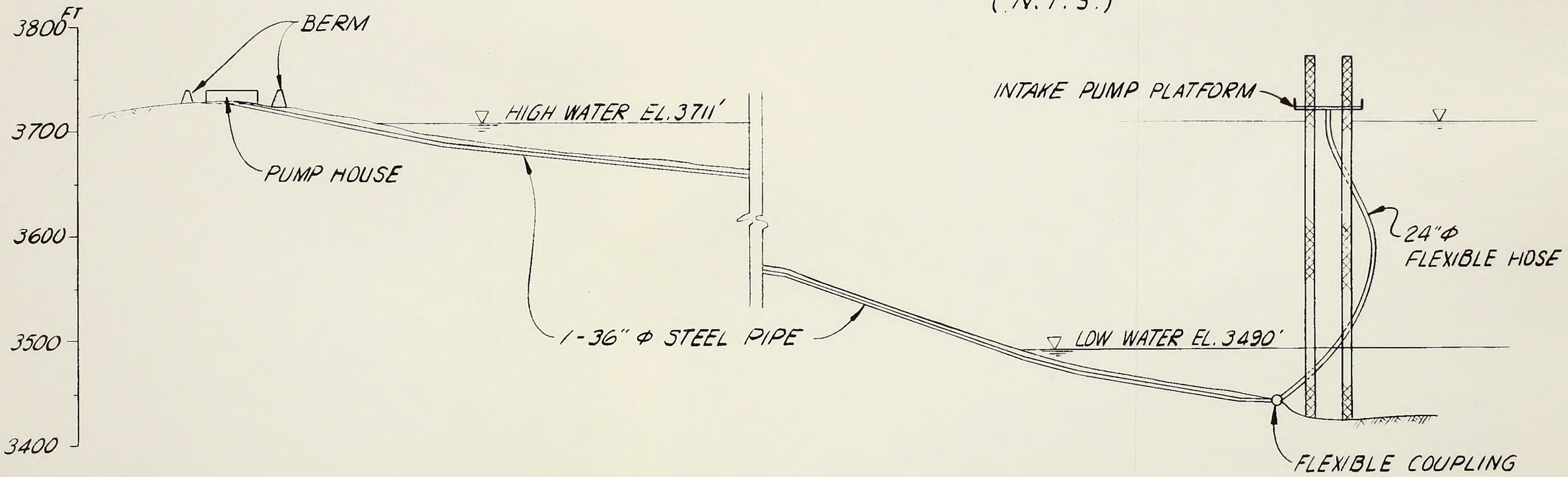
Pipeline alternatives

Alternates to the proposed pipeline route across Nipple Bench are shown in Illustration 13 thru 15. The Smoky Mountain route (41 miles long) was selected to provide the shortest route for the Romana Mesa intake. The Nipple Creek West route (35 Miles long) was selected because the main plant access would be from Glen Canyon City via Nipple Creek. Construction and use of the roads would be as previously described in Chapter I.

For all routes, power distribution from the plant site would be over the same corridor as the pipeline. For both alternate routes transmission lines would be longer than for the proposed Nipple Bench route. Added pipeline length would increase total power requirements to about 41,000 horsepower for the Nipple Creek route and 47,000 horsepower for the Smoky Mountain route, as compared to 39,000 for the proposed route.



EXCAVATION FOR PIPE
(N.T.S.)

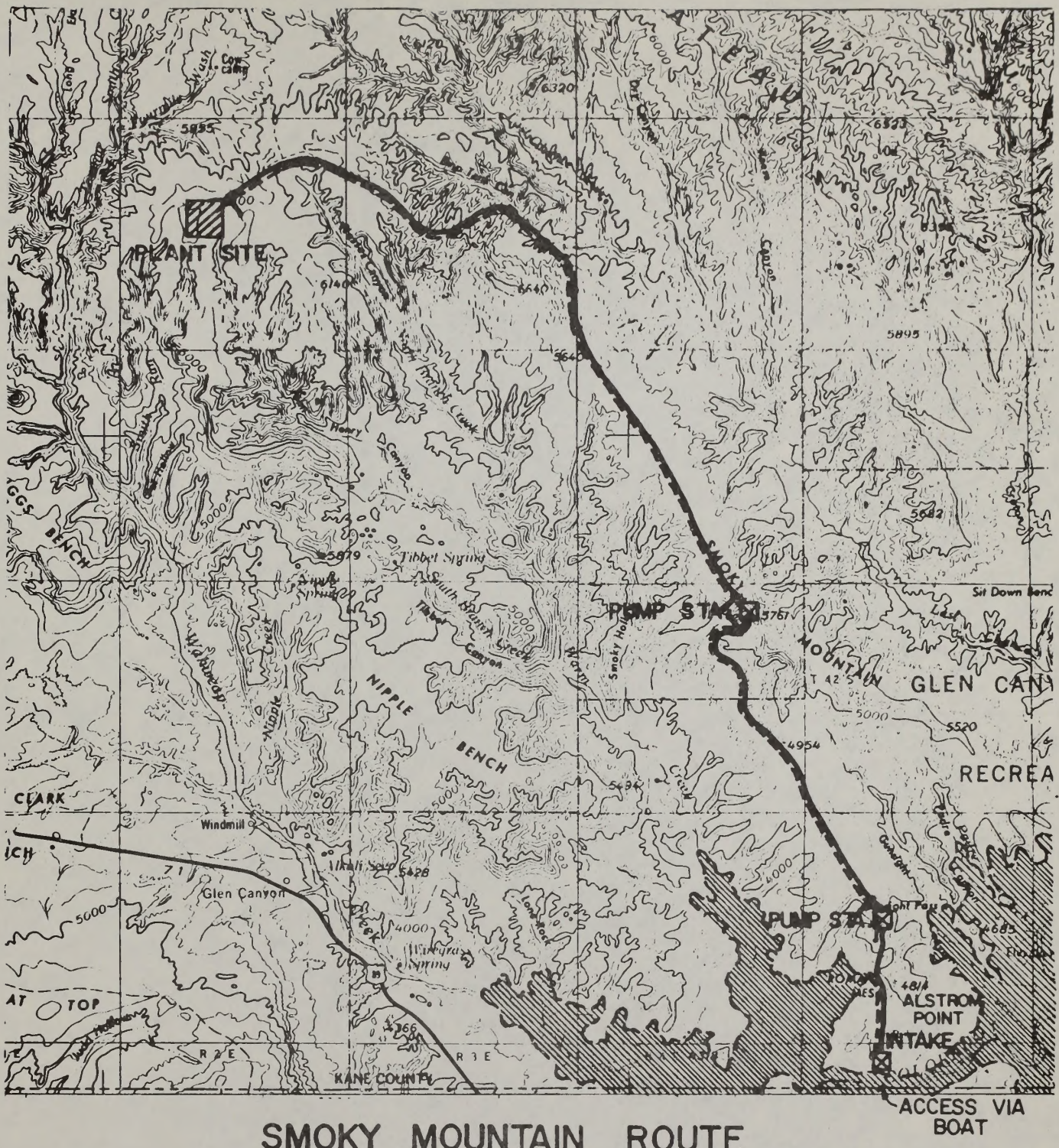


SCALE HORIZ. 1"=200'
VERT. 1"=100'

JACK-UP OFF SHORE PLATFORM-WARM CREEK

ILLUSTRATION 12





SMOKY MOUNTAIN ROUTE
ROMANA MESA INTAKE
FOURMILE BENCH PLANT SITE

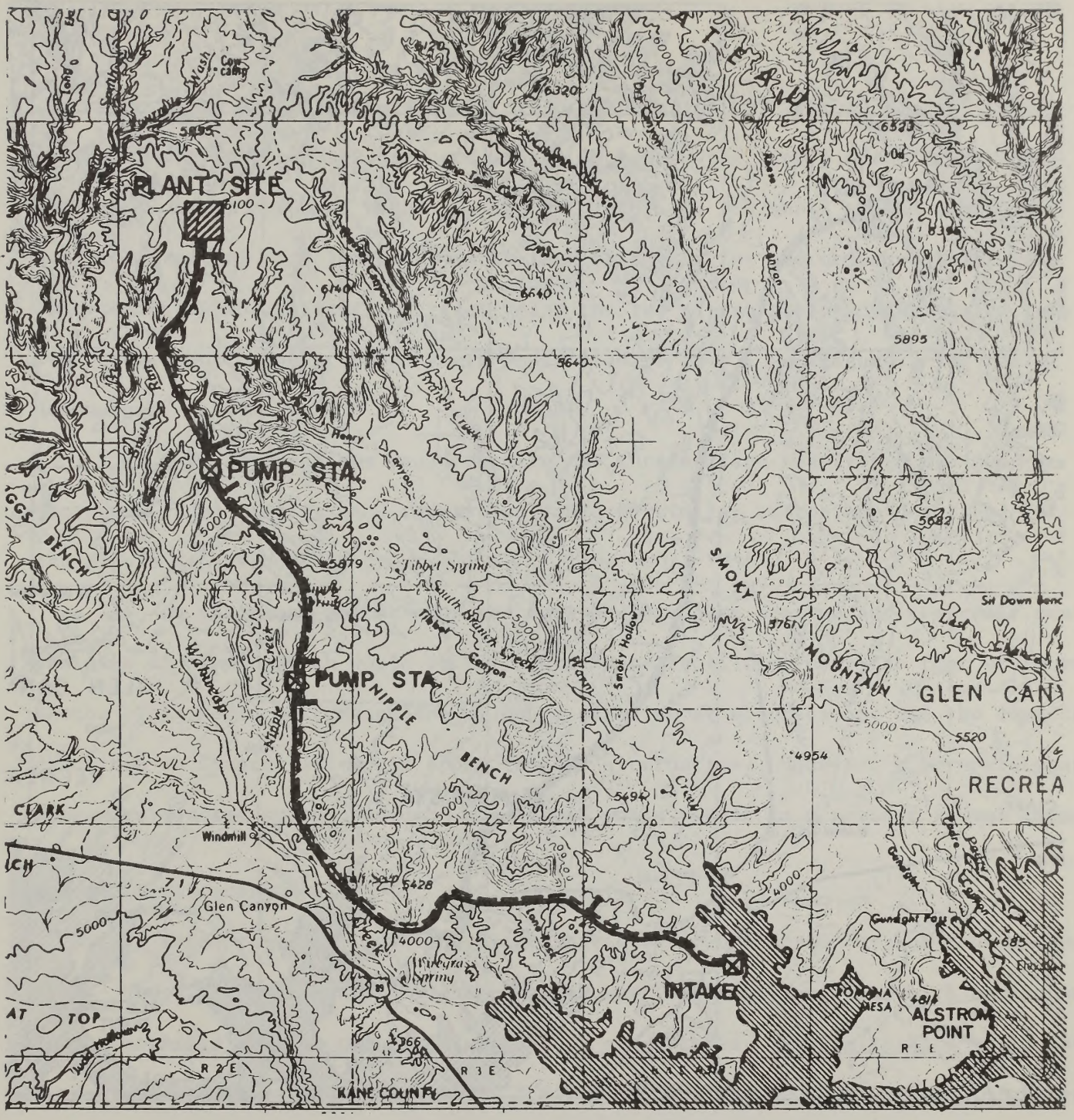
LEGEND

PIPELINE

PATROL ROAD

PATROL ROAD GATE TO PROHIBIT PUBLIC ACCESS

ILLUSTRATION 13



NIPPLE CREEK WEST ROUTE
WARM CREEK INTAKE
FOURMILE BENCH PLANT SITE

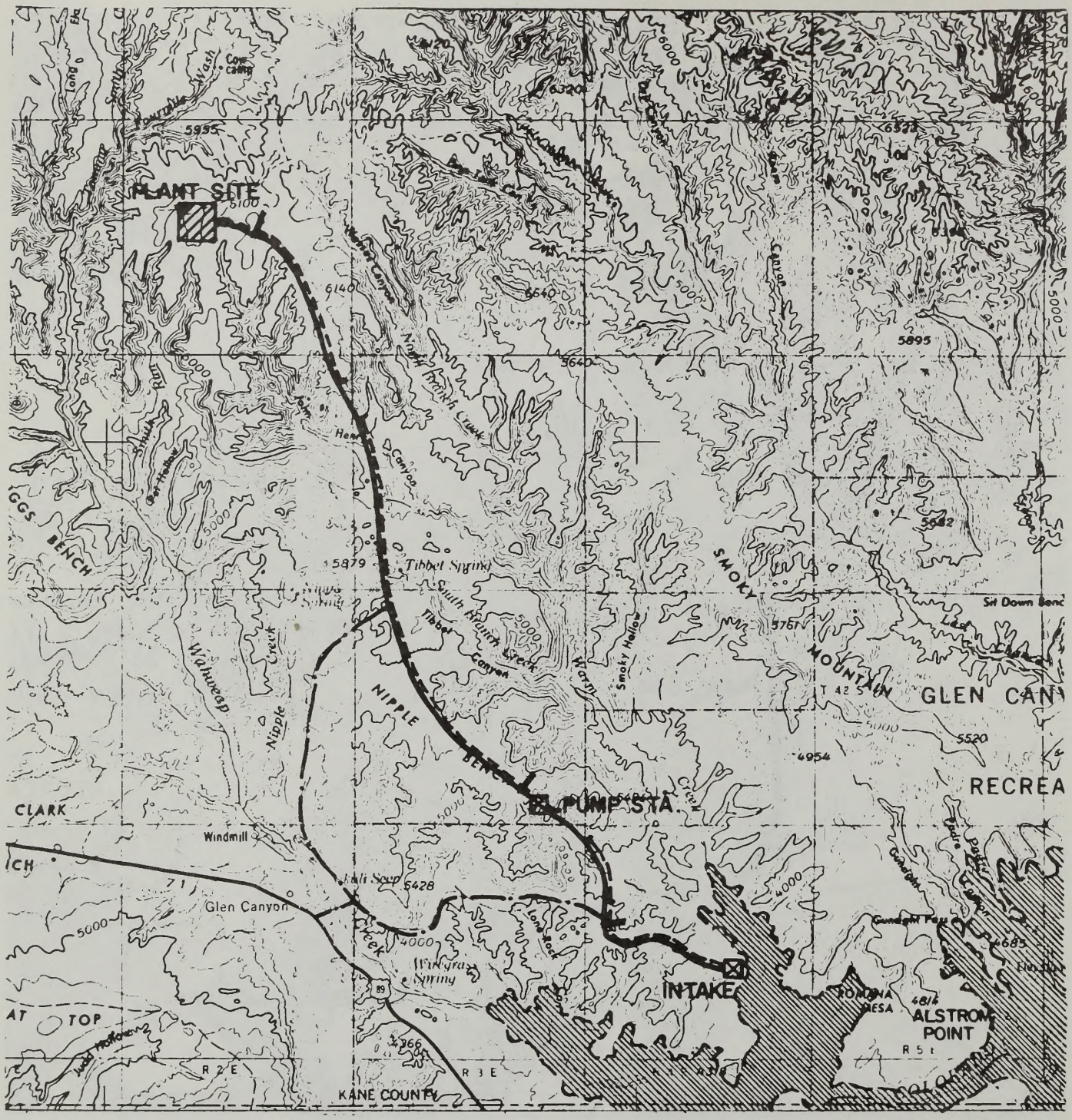
LEGEND

PIPELINE

PATROL ROAD

PATROL ROAD GATE TO PROHIBIT PUBLIC ACCESS

ILLUSTRATION 14



NIPPLE BENCH ROUTE
WARM CREEK INTAKE
FOURMILE BENCH PLANT SITE

LEGEND

- PIPELINE
- PATROL ROAD
- ACCESS ROAD
- PATROL ROAD GATE TO PROHIBIT PUBLIC ACCESS

ILLUSTRATION 15

Smoky Mountain route would disturb approximately 27 more acres for pipeline construction than the proposed route. However, the Nipple Creek West route would follow the proposed highway alignment in places and would reduce required access and patrol road lengths by more than half that for the proposed route and also the Smoky Mountain alternative. Also the two alternatives would require only two bridges while the proposed route would require five. See Figure 2 for route comparison.

Both alternatives would require two intermediate reservoirs and pump stations. Pump stations and reservoirs would be similar to the one described for the Nipple Bench route in Chapter I.

An alternate to the proposed intermediate pump station and reservoir near the edge of Nipple Bench would be to locate these facilities near the foot of Fourmile Bench. This would not change the miles of pipeline or access road, and the impacts described in Chapter III would apply to this alternative. However, a more elaborate microwave control system would be needed and would result in a greater visual impact.

Reservoir alternatives

Three reservoir location alternatives were considered for the Fourmile Bench site. These alternates are designated as 10 west, 10 east, and 11, which correspond to the township section number in which they are located. Each alternate would have a reservoir capacity of approximately 2,640 acre-feet (86,000,000 gallons) of water--enough to supply the station for 14 days at maximum capacity during the hottest summer month.

Reservoir alternates 10 east and 11, have a crest width on the dam of 30 feet with a 24-foot wide asphaltic-concrete paved road encompassing the reservoir. These two alternatives have similar features: an inlet structure, a three-foot diameter concrete encased pipeline through the dam fill, and a pump structure near the downstream toe of the dam which would pump reservoir water to the power block. Alternate 10 west, which is almost entirely in cut and therefore would not have any

FIGURE 2

Pipeline Route Comparison for Fourmile Bench Plant Site

Pipeline Route - Intake	Pipeline Length	Access and Patrol Road Length	Number of Bridges	Number of Intermediate Pump Stations	Number of Reservoirs
Nipple Bench - Warm Creek	30.0 miles	43.8 miles	5	2	1
Nipple Creek West - Warm Creek	35.0 miles	13.3 miles*	2	2	2
Smoky Mountain - Romana Mesa	41.0 miles	40.4 miles	2	2	2

* Part of this route would follow the proposed new highway alignment.

large dam, was designed for suction pumps at the reservoir to pump water to the power block.

All three alternates would have a minimum freeboard of five feet and would have a spillway structure for bypassing storm flows in excess of a 100-year storm. All the alternatives are located so that a safe drainage path would be provided for floodwaters in the event some natural or man-caused mishap should lead to a break in the dam.

Alternate 10 west would be at the northern part of the site in the southwestern part of Section 10. The reservoir would be almost totally in a cut; it would have an average depth of approximately 50 feet and encompass an area of approximately 50 acres.

Alternate 10 east would be located in the southeastern part of Section 10 and encompass an area of approximately 65 acres. The average depth would be approximately 40 feet and the amount of fill required would be nearly equal to the amount of cut required for the reservoir. The main part of the dam would be located at the northeast side of the reservoir.

Alternate 11 would be in the southwestern part of Section 11 and also encompass an area of approximately 65 acres with an average depth of approximately 40 feet. The dam would be along the northern and eastern sides of the reservoir. This alternate would require approximately 1.25 million cubic yards more cut than fill for the reservoir construction. The impacts of these alternate reservoir sites would be the same as the proposed site as discussed in Chapter III.

Alternative pond linings

Linings are being considered for use in the reservoir to reduce water loss by seepage. Alternates being considered are listed below.

Asphalt

This alternate would use a high asphalt content paving mixture and standard paving equipment.

Blown asphaltic membranes are also being considered but must be protected, like clay or other membranes.

This alternate would increase sand and gravel needs by approximately 26,000 cu. yards. The seepage rate would be less than that of the proposed lining which is 0.05 inches/year. However, asphalt linings are prone to cracking and would possibly create higher seepage losses and possible pollution to ground water.

Commercial membranes

Various chemical manufacturers have developed membranes which are commercially sold as pond liners. These materials include polyethylene, polyvinylchloride, hypalon, butyl rubber and several others. Due to petroleum shortages, some of these may not be available. A protective soil cover would be placed over the membrane. These membranes have a lower seepage rate than the proposed mudstone lining; however, they are easily punctured and may cause a higher seepage rate.

Soil cement

A mixture of natural soils with Portland cement has been used on several projects for lining. This alternate, however, would be highly susceptible to cracking due to the rigidity of the material. If the lining cracks, seep losses would occur and possible pollution of ground water.

Cooling system alternatives

Cooling ponds

Cooling ponds are simply open bodies of water which use natural heat exhange processes of evaporation, radiation, and conduction-convection to dissipate a power plant's waste heat load.

Cooling ponds offer advantages such as serving as a settling basin, operating for extended periods without makeup water, eliminating drift losses and resultant adverse environmental effects of drift on soils and vegetation, and providing possible recreation such as boating.

Disadvantages of this alternative are the requirement of a large land area of approximately 6,000 acres which is 5,995 more acres than needed for cooling towers, causing the destruction of existing biota and a probability, under certain cold weather conditions, of fogging and icing in the immediate area. Fog with cooling ponds will generally be at ground level, while cooling tower fog will usually be at some altitude above the ground. Also water consumption would be increased by 16,500 acre-feet annually due to evaporation.

To prevent seepage and water loss, cooling ponds would require liners similar to those applied to evaporation ponds.

Spray ponds

Nozzles are used in spray ponds to atomize water into fine sprays which contact ambient air. Spray ponds depend on wind speed and direction. Although they require less land area than cooling ponds, they require 95 more acres of land (with resultant loss of biota) than do cooling towers. However, this may be offset by the more widespread cummulative biotic losses from salt drift of cooling towers.

Spray ponds to meet heat rejection requirements of the plant, would need to consist of approximately 360 spray modules which would require approximately 75 horsepower each, and consume 20 mw of electricity. Approximately 100 acres of land would be required for a spray canal approximately 28,800 feet long, 150 feet wide and 10 feet deep. Spray ponds designed for comparable performance to that of wet cooling towers would have approximately the same auxiliary power requirements. Horsepower requirements of additional pumps for spray modules would be compensated by a reduction in circulating water pumping power and elimination of cooling tower fan power.

Wet-dry cooling towers

A mechanical draft wet-dry cooling tower includes a dry section with a conventional wet tower to lower relative humidity of air rejected from the tower.

The wet-dry cooling tower has been applied to plants where water conservation was an overriding criteria.

There are two basic types of mechanical draft wet-dry cooling towers available, the series flow and parallel path. The series flow tower has a dry section that either precedes or follows the wet section of the tower. In the parallel path wet-dry tower, ambient air travels in parallel streams through a dry surface exchanger and an evaporative section. Both streams mix after leaving their respective sections. This mixing would reduce relative humidity or moisture content of the tower effluent and consequently would reduce, or eliminate, the frequency of plume formation.

The two basic types of towers may be further divided into plume abatement and water conservation designs. The only difference between the designs would be the ratio of the amount of dry section to wet section. The plume abatement tower has a dry/wet ratio of approximately 0.4:1. The water conservation tower would have a dry/wet ratio of approximately 2.45:1.

As the dry section cooling would be inherently less efficient than the wet section cooling, fan power and pumping power would be increased 20 to 30 percent, depending on the design.

A wet-dry water conservation cooling tower designed for winter ambient conditions would cost six times as much as a comparable wet cooling tower. No reliability data exists at this time on wet-dry towers due to an extremely short period of actual operating time. According to participants, there are only two wet-dry, plume abatement cooling towers in operation within the United States (and no water conservation cooling towers): one 14 cell wet-dry cooling tower for a 500 unit mw unit, in operation less than one year, and one small 3 cell wet-dry cooling tower built for a chemical plant, in operation just over a year. Also, Utah Power & Light is planning wet-dry cooling towers for their 830 mw power plant in Emery County scheduled for completion in 1979.

The water saving of a plume abatement wet-dry cooling tower would be rather small and is estimated to be about five to ten percent of the total water requirement for a comparable wet cooling tower, or an annual savings of approximately 2,225 to 4,450 acre-feet of water. Water saving of a water conservation wet-dry cooling tower would be significant and is estimated to be about 60 percent of the total water requirement for a comparable wet cooling tower.

Water consumption from a wet-dry tower would vary considerably, depending on design (i.e., percent dry versus percent wet), operation and meteorology. Fogging and icing could also be controlled by design and operation. Salt accumulation from drift losses would be reduced. Also, the limited experience with this system results in lack of information regarding its reliability, maintainability and other operating characteristics. All other impacts to the environment except salt drift from the presence of wet-dry cooling towers would be the same as those described in Chapter III.

Dry cooling towers

Dry cooling towers use air as the cooling medium to reject heat from the power plant to the surrounding atmosphere.

Turbine cycle thermal efficiency using dry cooling towers, is estimated to be poorer by four to ten percent than a conventionally cooled turbine cycle. Thus a dry cooling tower plant would require up to 10 percent more fuel, or an additional 900,000 tons of coal annually. It would also reject up to 18 percent more heat to the surroundings compared to a conventionally cooled (wet cooling tower) power plant.

For a dry cooling tower plant application, the turbine must be capable of operating at higher peak back pressures of approximately 10 to 14 inches of mercury absolute (in. Hg. Abs.) and at a much wider variation of back pressures. Turbines presently designed for conventionally cooled (wet cooling tower) plants -- operating between slightly less than 1.0 in. Hg. Abs. to 4.0 in. Hg. Abs. with a maximum design back pressure of 5.0 in. Hg. Abs. -- would not be suitable for the severe performance

requirements of dry cooling tower plants. Turbine generators suitable for the high back pressure required by a dry cooling tower plant are not currently in production.

The large exposed heat transfer surfaces of a dry cooling tower are susceptible to rapid cooling and possibility of freezing the condensate inside the finned tubes during cold weather. The result is reduced load operation or an accidental loss of load. With direct contact condensers and condensate circulating through the towers, no antifreeze substance may be used. A startup in freezing weather would be a difficult task for the operators. Experience available does not provide a solid basis to assess lifetime reiability, maintainability and other operating characteristics of this equipment.

Water consumption by a dry cooling system would be essentially zero. Dry cooling would eliminate problems of fogging, icing, drift and blowdown. There is controversy over what the environmental impact might be from large quantities of warm air discharge into the atmosphere. The potential modification of local meteorology, such as triggering the formation of cumulus clouds, requires further study.

There is an increased noise problem with dry cooling towers, due to forced air systems used. Dry cooling towers would not disturb or become detrimental to soil, vegetation and wildlife any more than wet cooling towers; however, there would be no salt drift which would be detrimental to vegetation and soils.

Evaporation pond liner alternative

These pond lining alternatives were discussed previously for the reservoir under "Waste supply system and storage -- reservoir alternatives".

Administration building, shop and warehouse facilities

According to the participants, the administration, shop and warehouse facilities do not have alternatives which would be significantly different from the proposed action. Impacts would be the same as discussed in Chapter III.

Access roads

Although there may be minor changes in on-site road alighments during final engineering, basic area and mileage of on-site roads are expected to remain approximately as projected in the proposed action. Impacts would be the same as discussed in Chapter III.

Fuel oil system

One alternative to a fuel oil system would be natural gas. Similar coal-burning plants within the Edison system use natural gas for main boiler ignition systems and auxiliary boiler steam generation. However, in recent years availability of natural gas has substantially decreased, and future projections indicate an almost total absence of gas for the generation of electricity.

Another alternative to a fuel oil system would be propane. A disadvantage of this system would be the potential limited supply of propane and the quantity involved. Approximately 27,000 tons per year or a total of 810,000 tons would be required for normal plant operation during the years 1985 to 2015.

Lime/limestone supply and handling alternatives

Limestone produced in the participants' proposed quarry is not directly suitable for use in scrubbers at the power plant or for rock dusting in the underground coal mines and must be processed. Seven alternative limestone processing and handling systems were considered by the participants:

(1) Processing at plant site for plant site needs, and at the coal mine for mine needs; lime used for SO_2 removal.

(2) All processing at quarry site; lime used for SO_2 removal.

(3) Purchasing from outside supplier; lime used for SO_2 removal.

(4) All processing at plant site; limestone used for SO2 removal.

(5) Processing at plant site for plant site needs, and at coal mine for coal mine needs; limestone used for SO_2 removal.

(6) All processing at quarry site; limestone used for SO_2 removal.

(7) Purchasing from outside supplier; limestone used for SO_2 removal.

A summary of parameters involved in evaluating the seven alternatives and the proposed action is presented in Figure 3.

Lime needed for water pretreatment would be purchased from outside suppliers for the alternatives that would use limestone for SO_2 removal.

Alternative 1: Processing at plant site for plant needs and at coal mine site for coal mine needs with lime used for SO_2 removal and water pretreatment.

Processing and handling of limestone at the quarry for alternative 1 is the same as described in the "Limestone Quarry" description, Chapter I.

Crude limestone would be hauled to the plant site for conversion to lime for use in SO_2 removal and water pretreatment systems.

The lime/limestone handling system on the plant site for alternative 1 would be similar to the proposed action. Amounts of limestone needed and lime produced are the same as for the proposed action. The difference between alternative 1 and the proposal is that the limestone waste stream (particles less than ¼") from the lime processing system would not be processed on the plant site. This limestone would be hauled to the coal mine for further processing.

Crushed and screened limestone would be delivered to the coal mine from the generating station. Approximately the same amount of limestone and the same number of trucks would be used as in the proposed action. The limestone would then be crushed and ground at the coal mine with the related screening operations to produce the rock dusting material at 100 percent minus 20 mesh and a minimum of 70 percent minus 200 mesh. This material would be retained in an enclosed storage area until needed at various mine portals.

FIGURE 3

Kaiparowits Project Limestone Alternatives for Johns Valley Site
(Estimated quarry quantities and requirements)

	Proposed Action, Chapter I	Alternative						
		1	2	3	4	5	6	7
Requirements								
Coal mine	←220 tpd pulverized limestone, five days per week→							
Scrubbers -- Lime	←280 tons every day→							
Limestone					490 tons pulverized limestone/day			
Major Construction								
Access road	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Miles	22	22	22	--	22	22	22	--
Surface road	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Miles	40	40	40	--	40	40	40	--
Shop/office	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Quarry road	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Miles	2	2	2	--	2	2	2	--
Water supply	Small	Small	Small	None	Small	Small	Small	None
gpm	1.5	1.5	5.0	--	1.5	1.5	5.0	--
Transmission power line	No	No	Yes	No	No	No	Yes	No
Miles	--	--	31	--	--	--	31	--

(Continued)

FIGURE 3 (Continued)

	Proposed Action, Chapter I	Alternative						
		1	2	3	4	5	6	7
Major Construction (Continued)								
Crushing and grinding facilities	One	Two	One	None	One	Two	One	None
Kiln	Yes	Yes	Yes	No	No	No	No	No
Covered storage at quarry	No	No	Yes[a]	No	No	No	Yes	No
Highway Traffic Density[b]								
Limestone	30	30	8	--	30	30	30	30
Lime	--	--	13	13	½	½	½	½
Coal	--	--	6[c]	--	--	--	--	--
Estimated employee's trips	21	23	19	--	18	19	18	--
Estimated Employees Required								
Total	60	65	55	--	55	58	55	--

(Continued)

a Coal, lime and rock dust
b Trips per day on six-day basis and 25-ton payload
c Return

FIGURE 3 (Continued)

	Proposed Action, Chapter I	Alternative						
		1	2	3	4	5	6	7
Surface Disturbance (Acres)								
Highway surfacing (existing unimproved roads)	80	80	80	--	80	80	80	--
Shop/office	5	5	5	--	5	5	5	--
Quarry	131	131	131	--	131	131	131	--
Quarry access road	18	18	18	--	18	18	18	--
Magazines	3	3	3	--	3	3	3	--
Limestone stockpile	3	3	4	--	3	3	4	--
Crushing and grinding	--	--	2	--	--	--	2	--
Kiln	--	--	2	--	--	--	--	--
Transmission line	--	--	18	--	--	--	18	--
Covered storage (limestone, lime, and coal)	--	--	1	--	--	--	1	--
Total	240	240	264	--	240	240	262	--

Alternative 1 would have the advantages of concentrating industrial facilities within complex sites where basic operations are scheduled on a 24-hour per day basis. A disadvantage would be inefficiency resulting from increased manpower required to operate two small crushing plants. The impacts of this alternative would be the same as those discussed in Chapter III.

Alternative 2: All processing at quarry site with lime used for SO_2 removal and water pretreatment

Alternative 2 concerns construction of the same processing facility proposed at the power plant, but located instead at the quarry site. Site selection at the quarry would be adjacent to the shop/office and limestone stockpile areas immediately to the side of the main quarry access road. Crushing and grinding facilities, the kiln and its bag-house equipment, and the enclosed stockpiles for various fuels and products would be constructed in Johns Valley, Utah. An electrical transmission line of approximately 15 miles would have to be constructed to the Johns Valley site. Process facilities would require approximately four additional acres.

This facility would be used on a seven-day basis to convert 490 tons of crude limestone per day into 280 tons of lime per day to be used at the generating station for SO_2 removal and water pretreatment. Lime would be hauled to the generating station in enclosed trailers six days a week. An additional 220 tons of pulverized limestone per day would be produced five days a week for rock dusting in the underground coal mines. This would be hauled to the coal mine in enclosed trailers six days a week. Approximately seven trucks per day on the return trip from the generating station would haul a total of 175 tons of pulverized coal per day to fire the rotary kiln; this is 105 tons per day greater than the proposal.

Lime delivered from the quarry site would be unloaded pneumatically from trucks into the storage bin at the plant site. The lime would then be handled the same as described in the "Limestone/Lime Supply and Handling" discussion in the plant description of Chapter I. Truck loading facilities would be provided at the plant

site to load coal needed at the quarry to fire the kiln. Dust suppression systems at the truck loading facility would be provided.

Pulverized limestone for rock dusting, delivered to the coal mine from the quarry site, would be handled at the coal mine in the same manner described in the "Coal Mine" description in Chapter I.

The greatest advantage of this alternative would be reduction in highway transportation required for hauling lime material rather than limestone to the power plant site. Approximately eight fewer trips per day (48 trips per week) would be required.

Disadvantage of this system would be that the quarry schedule is not proposed to operate on a three shifts per day, seven days per week schedule. It would be necessary to construct a larger water system to supply 116 acre-feet annually of additional water to support calcining at the quarry site. Water in the limestone quarry area is in short supply as all water rights are appropriated at the present time. Surface disturbance from constructing the power line and kiln facilities is estimated to be approximately 22 acres. Such surface disturbance would reduce vegetative cover necessary for one deer per year wintering in the area prior to surface rehabilitiation.

Alternative 3: Purchasing from outside suppliers with lime used for SO_2 removal and water pretreatment

Since lime would be purchased from an outside supplier, no processing equipment would be needed by the participants. Thus, no facilities would be needed by participants for transporting coal to the kiln. Facilities and amounts of lime handled on the plant site would be the same as in Alternative 2.

Handling of the pulverized limestone for rock dusting at the coal mine would be the same as described under "Coal Mine Description", Chapter I.

The 240 acres of quarry in Johns Valley would not be disturbed or occupied by man-made facilities. This would allow at least ten deer to continue wintering in the area.

A disadvantage of alternative 3 would be that all known outside lime and limestone suppliers are at a much greater distance from the plant site and mine than the proposed quarry. Thus, increased truck railroad haul distance would use more energy to supply lime and limestone. Actual haul distances are not known at this time. An additional disadvantage of having an outside lime and limestone supplier would be lack of control over the source. Control over the source would help insure availability of material needed for SO_2 control and rock dusting.

Alternative 4: All processing at the plant site with limestone used for SO_2 removal and purchased lime used for water pretreatment

Processing and handling of limestone at the quarry for alternative 4 would be the same as described in "Limestone Quarry" description, Chapter I. All processing and handling of limestone would be done at the plant site as described in the "Limestone/Lime Supply and Handling" under the plant description of Chapter I. However, instead of lime being used in the SO_2 removal system, limestone would be used and the kiln process would not be required. Approximately the same amount of limestone would be needed for this alternative. Lime would still be needed for water pretreatment and would be purchased from an outside supplier.

Processing and handling of limestone at the coal mine for alternative 4 would be the same as described in the "Coal Mine" description, Chapter I.

Advantage of this alternative is that all limestone processing facilities would be at the plant site where power, water and other facilities would be readily available and the need for a kiln would be eliminated. Coal consumption would be reduced by 70 tons per day, or 894,250 tons during the life of the project. All other impacts would be the same as discussed in Chapter III.

Alternative 5: Processing at plant site for plant needs and at coal mine site for mine needs with limestone used for SO_2 removal and purchased lime used for water pretreatment

Processing and handling of limestone at the quarry for alternative 5 would be the same as described in "Limestone Quarry" description of Chapter I.

Alternative 5 is similar to alternative 4 except that the limestone needed for the coal mine would be processed at the coal mine instead of the plant site. Lime needed for the water pretreatment system would be purchased from an outside supplier.

Alternative 5 would require less handling of material at the plant site because limestone for the mine would be handled at the mine. The total material handled at the mine and plant remains the same.

Crude limestone would be delivered to the coal mine from the quarry. Approximately the same amount of limestone and the same number of trucks would be used as in alternative 4. Limestone would then be crushed and ground with related screening operations to produce rock dusting material at 100 percent minus 20 mesh and a minimum of 70 percent minus 200 mesh. This material would be retained in an enclosed storage area until it was needed at various mine portals.

Alternative 5 would have the advantages of concentrating industrial facilities within complex sites where basic operations are scheduled 24 hours per day. A disadvantage would be the inefficiency resulting from the increased manpower required to operate two small crushing plants. All impacts resulting from this alternative would be the same as those discussed in Chapter III.

Alternative 6: All processing at quarry site with limestone used for SO_2 removal and purchased lime used for water pretreatment

Alternative 6 concerns construction of the same processing facility proposed at the power plant in alternative 4, but located at the quarry site. Site selection

at the quarry would be adjacent to the shop/office and limestone stockpile areas immediately to the side of the main quarry access road. Crushing and grinding facilities and the enclosed stockpiles for various fuels and products would be constructed in Johns Valley. An electrical transmission line of approximately 15 miles would have to be constructed to the Johns Valley site. Processing facilities would require approximately two additional acres.

This facility would be used seven days a week to process 490 tons of crude limestone per day to be used for SO_2 removal at the generating station. Limestone would be hauled to the generating station in enclosed trailers six days a week. An additional 220 tons of pulverized limestone per day would be produced five days a week for rock dusting in the underground coal mines and hauled to the coal mine in enclosed trailers six days a week.

In alternative 6, limestone would be processed at the limestone quarry before being hauled to the plant site. Limestone delivered from the quarry site would be unloaded from trucks into a storage bin. A dust suppression system using non-toxic chemicals at the truck unloading facility would be provided. Lime would be purchased from an outside supplier for the water pretreatment system.

Pulverized limestone delivered to the coal mine from the quarry site for rock dusting would be handled at the coal mine in the same manner as described in the "Coal Mine" description of Chapter I.

The impacts resulting from this alternative would be the same as those described for alternative number 2.

Coal mine design

Mining methods

Surface mining methods

Surface mining methods remove overlying strata (overburden), thereby exposing minerals for subsequent recovery. Two surface mining methods -- conventional area strip, and multiple-bench open-pit can be analyzed for use on the Kaiparowits Plateau.

Conventional strip mining can be used where coal occurs in multiple beds, as in the Kaiparowits Plateau; however, current technology limits the method to areas where coal is overlain by no more than about 180 feet of overburden.

Since most of the Kaiparowits Plateau coal beds are overlain by a minimum of about 400 to 500 feet of overburden, the conventional strip method cannot be used. The best alternative is the multiple bench, open-pit mining method where flat benches of varying widths and heights are developed to uncover coal. The resulting mine may resemble a large, wide staircase or a gigantic football stadium. As overburden from each bench is removed, coal deposits are uncovered and mined.

This method is most applicable where thicknesses of coal to be mined are relatively large in comparison to the overburden to be removed, where much of the coal is too deeply buried to be uncovered by conventional methods, and where multibed occurrence of coal prevents orderly disposal of waste overburden without excessive rehandling.

Where the method is used to mine multiple beds of coal, such as those found in the Kaiparowits Plateau, coal is actively mined on more than one bench at a time. Consequently, waste material (either overburden or rock between separate coal beds) must be transported away from the active portion of the mine and disposed of either outside the mine or in previously mined-out sections. Depending on mine design and distances which waste must be hauled, mining can be

conducted by power shovels, front-end loaders, or bucket-wheel excavators loading into trucks, trains, or conveyor belts for disposal. As in conventional strip mining, motorized scrapers, in conjunction with bulldozers, may be used to remove topsoil, regrade spoil piles, and excavate softer overburden.

To develop and recover the 420 million tons of coal required over the 35 year life of the project, an area of approximately seven miles east-west by four miles north-south or 28 square miles would be involved in the collective operation of the four underground mines recovering only 50 percent of the coal. If, however, the alternate multiple-bench, open pit alternative was used, an area of only about 14 to 15 square miles would be affected since coal recovery would be 90 percent or more. The average depth down to the uppermost coal bed ranges between 400 and 500 feet. Mining down through coal horizons would deepen excavations by approximately 150 to 200 feet. This would mean that a volume of about two cubic miles of material would be excavated.

Overburden disposal would initially be a problem as it would not be logical to place material from the first open pit on a surface that was scheduled for mining subsequently. Therefore, the only feasible location for disposal of any volume of initial overburden would be in the canyons. Since several open pits would likely be operated simultaneously to provide the 24,730 ton daily requirement for the generating station, several canyons would probably be selected as initial waste disposal sites until enough pit areas were mined out to provide locations for backfilling.

The impact on topography would be extensive, involving some 14 to 15 square miles. The entire appearance and shape of the surface would be altered. All vegetation and land forms would be obliterated and could never be restored as before in spite of any reclamation measures taken. Furthermore, effective rehabilitation would require several years before the area could be restored to a condition comparable to the original state.

The geology of the entire section would be altered by breaking up and relocating over 600 feet of waste strata and by the complete removal of several coal beds aggregating 40 feet of thickness. Any paleontological resources such as fossils, petrified wood or bones would be destroyed. All existing aquifers in excavated areas would also be obliterated.

Disposal of enormous volumes of waste in canyons would create a ready source of pollution to lower drainages during storm runoff.

The aesthetic impact of mining operations would be magnified since all activity would be in the open. Noise and air pollution would be greatly magnified by blasting and operation of various machines and vehicles even though preventative measures of muffling sounds and sprinkling to decrease dust were taken. Air pollution created by strong winds would be increased by the wide exposure of waste material and coal. Wildlife would be disrupted in and near pit areas by the activity and noise generation.

Surface mining would provide a safer working environment for the mine force than underground methods. Underground mining is statistically more hazardous than surface mining and man hour exposure to any hazards would be reduced since only about one-fourth as many miners (500) would be involved in surface mining operation.

In situ mining

In situ (in place) mining, more appropriately termed in situ gasification since the coal is not physically mined, is a process in which a portion of the in-place coal is burned to provide heat for destructive distillation of remaining coal. All operations are conducted through drill holes from the surface.

The process involves drilling numerous, closely spaced drillholes; hydraulic fracturing of the coalbed; ignition of in-place coal; injection of air or pure oxygen to support combustion, create heat, and cause destructive

distillation of coal; and capture and processing of resulting gases.

Impacts associated with this type of project would include numerous access roads to the multitude of drill holes, and associated equipment to draw off gases evolving from burning coal beds. A plant similar to those associated with coking coal at steel mills would be required nearby to process gases and route methane gas (CH_4) to the generating station for fuel. This plant would be similar to a typical oil refinery encompassing possibly a square mile.

Although this type of plant would contribute to air pollution, typical of any refinery, as well as some possible pollution caused by disposal of processing waters in the plant, fertilizers and other useful chemicals can be derived from coal gases that would otherwise be lost in normal power generation by the direct burning of coal. Additionally, a positive impact would be the elimination of waste ash normally associated with coal-fired generating stations.

At present, the process is experimental. Technology has not been developed to effectively control combustion, assure efficient recovery of the in-place resource, control surface subsidence, or to prevent water and air pollution from gasification of shallowly buried coal beds.

As with underground mining, in situ gasification would cause subsidence of overlying strata and possible surface degradation. Water-bearing aquifers located above the coal, may be ruptured. Water from aquifers could leak into and react with coal being gasified. Such leakage could further complicate a presently difficult process, pollute aquifers located below the coal seam, and pollute surface waters. Additionally, should subsidence break through to the surface, gas created by distillation and combustion could escape into the atmosphere.

Surface facilities involved with in situ gasification are more complex than those required for underground mining and less complex than those needed by surface mining. In addition to drill holes to the coal bed, pipeline systems to inject air or oxygen and to gather combustion products, plants to compress air

or extract oxygen from the atmosphere, and a plant to purify combustion projects must be installed. The process would also require a large network of closely spaced roads to service drill holes.

In situ mining causes more environmental impacts than either surface or underground mining.

Coal transportation methods

Transportation of coal from mine portals to the washery and from washery to powerplant could be accomplished by several alternative methods: off-highway trucks, railroads, or slurry pipeline.

Truck haulage

Off-highway trucks with capacities up to 200 tons could be used to provide coal transportation. Truck haulage would require operation of large numbers of trucks, construction of haul roads from mine portals to washery and from washery to powerplant, construction of additional maintenance facilities, and employment of additional personnel for drivers.

Impacts caused by truck haulage would be: increased surface disturbance by construction of haul roads and maintenance facilities; increased noise levels due to continuous operation of large trucks; and increased air pollution due to engine emissions, road dust and coal dust blown from the trucks. Additionally, coal would be spilled along haul roads, particularly around curves and as a result of accidents.

Coal dust and coal spillage from trucks could be controlled by covering the trucks. Surface disturbance due to construction of haul roads and maintenance facilities could not be mitigated. Air pollution from engine emissions and increased noise levels from truck operation could be partially controlled but not entirely eliminated.

Truck haulage is probably an impractical alternative to belt conveyor transportation. Capital expense of trucks, haul roads and maintenance facilities would probably exceed that required for the proposed conveyor system. Oper-

ation maintenance and labor costs of truck haulage would probably exceed those of proposed belt conveyors.

Truck haulage would provide more environmental impacts than a conveyor system. Surface disruption due to construction, noise levels inherent to operation, and air pollution due to engine emissions would all be substantially greater if trucks were used instead of belt conveyors.

Railroad

A railroad could be constructed linking mines to washery and washery to powerplant. Rail transportation of coal would eliminate all cross-country belt conveyors now proposed by the participants.

Due to rugged terrain in the area and shallow gradients traversable by railroad equipment, at least 40 miles of track would have to be constructed to connect all facilities.

Environmental impacts would be increased by surface disturbance due to construction of track and maintenance facilities, increased noise levels due to train operation, and increased air pollution due to engine emissions and from coal dust blowing from both loaded and empty cars. An accident, either a train wreck or a simple derailment, could cause significant coal spillage.

Coal dust could be controlled by using covered gondola cars. Surface disturbance due to construction could not be mitigated nor reduced. Air pollution from engine emissions and increased noise levels from train operation could be partially controlled but not entirely eliminated.

Railroad transportation is probably an impractical alternative to conveyor belt transport. Both capital and operating costs of rail transport would be higher than a conveyor belt system but probably lower than a truck haulage system.

A railroad haulage system would create approximately equal environmental impacts as truck haulage; however, impacts would be significantly greater

than the proposed conveyor system. Additional surface disruption due to construction, noise levels inherent to operation, and air pollution due to engine emissions would be greater with rail haulage than with belt conveyor.

Slurry pipeline

A slurry pipeline for coal transport, although technically feasible, is an economically unreasonable alternative to belt conveyor transportation for the short distances involved in the proposed project. Slurry pipelines offer some economic advantages for transportation over long distances. However, where distances are short, capital expense of a slurry pipeline and related facilites is prohibitive.

Site arrangement

The participants have proposed sites for all major components of the mining complex, but detailed engineering and environmental analyses may require location changes of some, or all, of the surface facilities. For example, the participants are continuing to explore their coal leases. Should exploration show that significant coal reserves are present in areas not now scheduled for mining, the entire layout of the mine complex could be changed. Individual components of the project, such as the washery or the conveyor belts, could be relocated in response to engineering or environmental analyses.

If major redesigning of the project is necessary, net impact on the environment would depend on whether additional facilities, in excess of those presently proposed, would be required or not.

Should no additional facilities be required, no additional adverse or favorable environmental impacts are foreseen. Impacts of construction and operation of the mine complex would be essentially equivalent, regardless of where surface facilities are located.

The same conclusion applies to an attempt to further centralize or

decentralize the project's components. Total surface area impacted would change only slightly in either case. Further centralization would concentrate impacts into a smaller area but the magnitude of each impact would probably be increased. Decentralization would reduce the magnitude of individual impacts by spreading them over a larger area. The crux of the centralization/decentralization question is whether a number of small impacts spread over a large area is more desirable than a number of large impacts concentrated into a small area. In either case, the overall impact would be unchanged.

Should project redesign require additional facilities, the overall environmental impact, as discussed in Chapter III, would be increased. Such an increase would probably be directly proportional to additional surface area required for added facilities.

Washery sites

Proposed site of the washery was selected as a result of intensive engineering and economic studies. Relocation of the washery to the central maintenance complex, to one of the mine portal areas, or to the generation station complex is feasible.

Relocation of the washery to the central maintenance complex or to one of the mine portals would not change environmental impacts caused by the proposed project. Either alternative would aggravate adverse impacts of the project, specifically by requiring additional conveyor belt linkages from each mine to the washery in place of a single trunk line belt conveyor as presently proposed. Surface intrusion of the project would be increased.

Relocation of the washery to the generation station complex would offer a partial mitigation to environmental impacts associated with the coarse refuse dump. However, overall adverse impact of the project would probably be slightly increased.

If the washery were located near the generation station, the coarse refuse dump could be combined with the ash disposal area. A coarse refuse/ash disposal dump would be smaller than the combined area of individual dumps since fine ash would tend to fill voids formed by deposition of coarse refuse. Fine tailings would continue to be deposited in a separate dump because water contained in fine tailings could leach trace elements from the ash creating an opportunity for surface or groundwater pollution.

A washery near the generation station would require, at minimum, a larger conveyor belt from the mine area to the new washery site and could require construction of a second parallel belt conveyor. In either case, an additional three million tons per year of material would have to be transported to Fourmile Bench.

A washery near the generation station would provide a net mitigation of impacts attributable to the present proposal unless two conveyor belts were required, in which case there would be no net adverse or favorable environmental impact, only a transfer of surface impacts from one location to another.

Transmission system

Introduction

This section is an analysis of each alternate transmission system route identified for the proposed project. In order to avoid unnecessary repetition, please refer to appropriate sections whenever an alternate to a proposed route either follows another proposed route or follows another alternate. If differences between a proposed route and one of its alternates are not significant, no new narrative is added, and reference should be made to appropriate sections of Chapter II through VII.

Routes

The number of alternates identified for each segment of the transmission system is as follows:

1. Kaiparowits to Eldorado - 14 alternates
2. Kaiparowits to Phoenix - 7 alternates
3. Kaiparowits to Mohave - 9 alternates
4. Mohave to Serrano - 7 alternates

Some of these alternatives involve deviations of only a few miles from the proposed route. Others are longer and replace 100 or more miles of a proposed route. This is especially true of the proposed Mohave to Serrano route.

Kaiparowits to Eldorado (Illustrations 16 to 16m)

Fivemile Canyon alternate

Description of alternate action

This alternate would follow the proposed route for approximately 12 miles from the Kaiparowits Generating Station site. Turning west for one mile, the alternate would cross Cads Crotch, pass through a draw in the Cockscomb Ridge, and then would drop to the floor of Cottonwood Creek Valley. The alternate then would proceed southwest for 3.9 miles, crossing the Utah Power and Light and Garkane Power Association wood pole transmission lines. It would parallel these existing lines down



PROPOSED KAIPAROWITS-ELDORADO ALTERNATE ROUTES

NORTHERN KAIPAROWITS-MOHAVE 500KV T/L

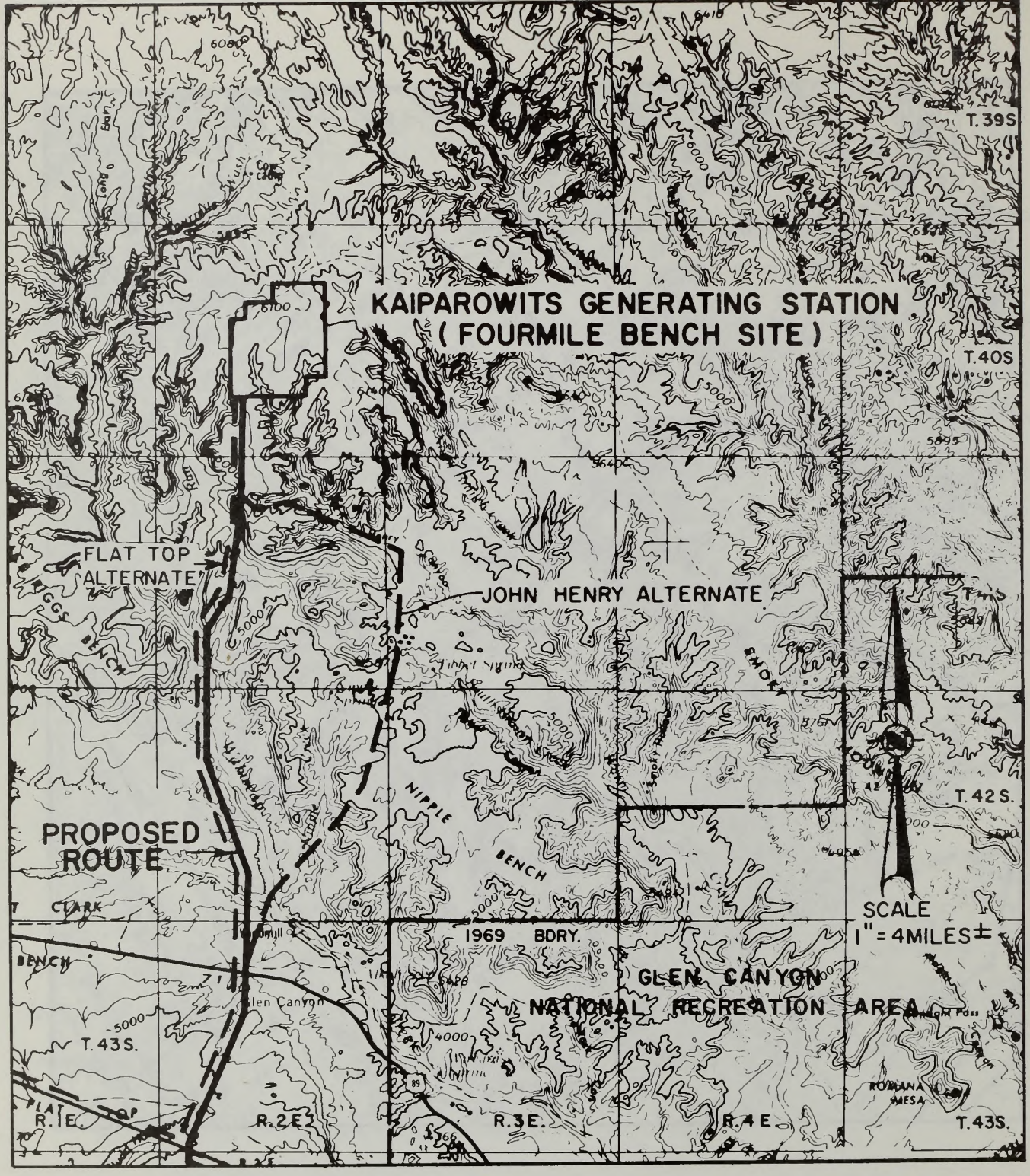
PREFERRED ALTERNATE, AND

ARIZONA STRIP 500KV T/L PREFERRED ALTERNATES

AND ALTERNATE ROUTES

4-7-75

ILLUSTRATION 16



PROPOSED KAIPAROWITS-ELDORADO ALTERNATE ROUTES
JOHN HENRY AND FLAT TOP ALTERNATES

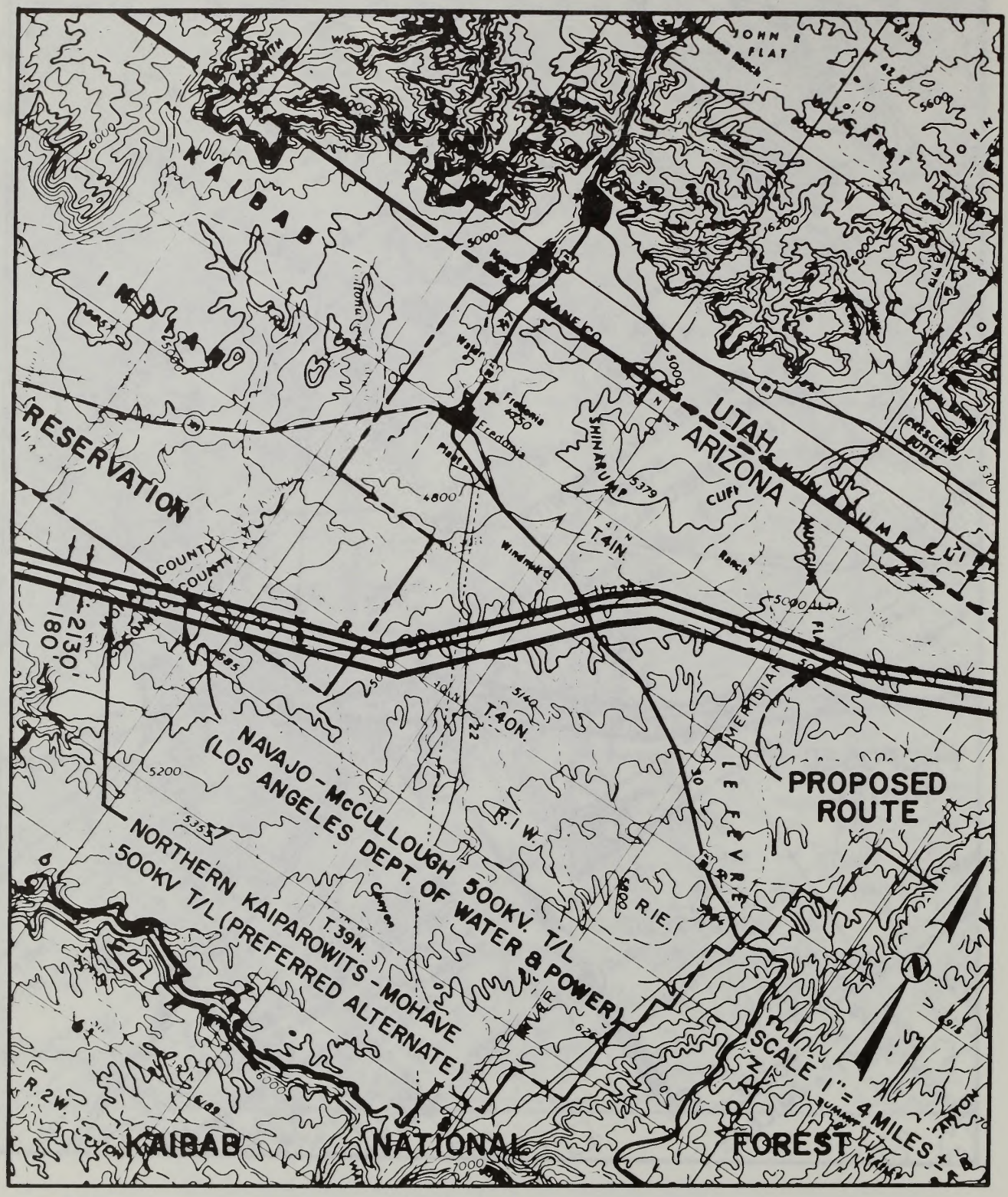
ILLUSTRATION 16 A



PROPOSED KAIPAROWITS – ELDORADO ALTERNATE ROUTES
NORTHERN KAIPAROWITS-MOHAVE 500KV T/L
PREFERRED ALTERNATE , AND
ARIZONA STRIP 500KV T/L PREFERRED ALTERNATES
AND ALTERNATE ROUTES

4-7-75

ILLUSTRATION 16 B



PROPOSED KAIPAROWITS – ELDORADO ALTERNATE ROUTES

NORTHERN KAIPAROWITS-MOHAVE 500KV T/L

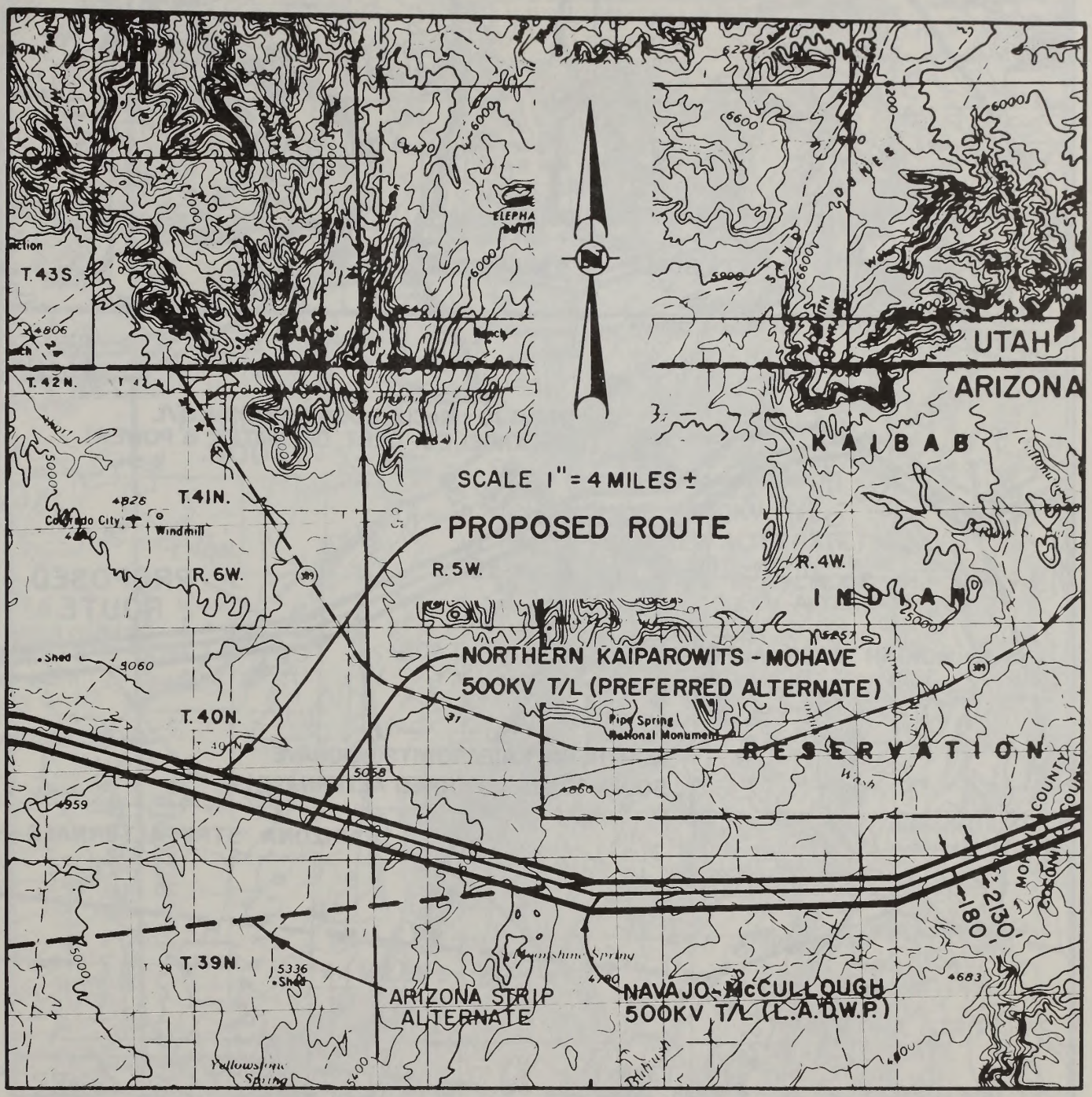
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4-7-75

ILLUSTRATION 16 C



PROPOSED KAIPAROWITS-ELDORADO ALTERNATE ROUTES

NORTHERN KAIPAROWITS-MOHAVE 500KV T/L

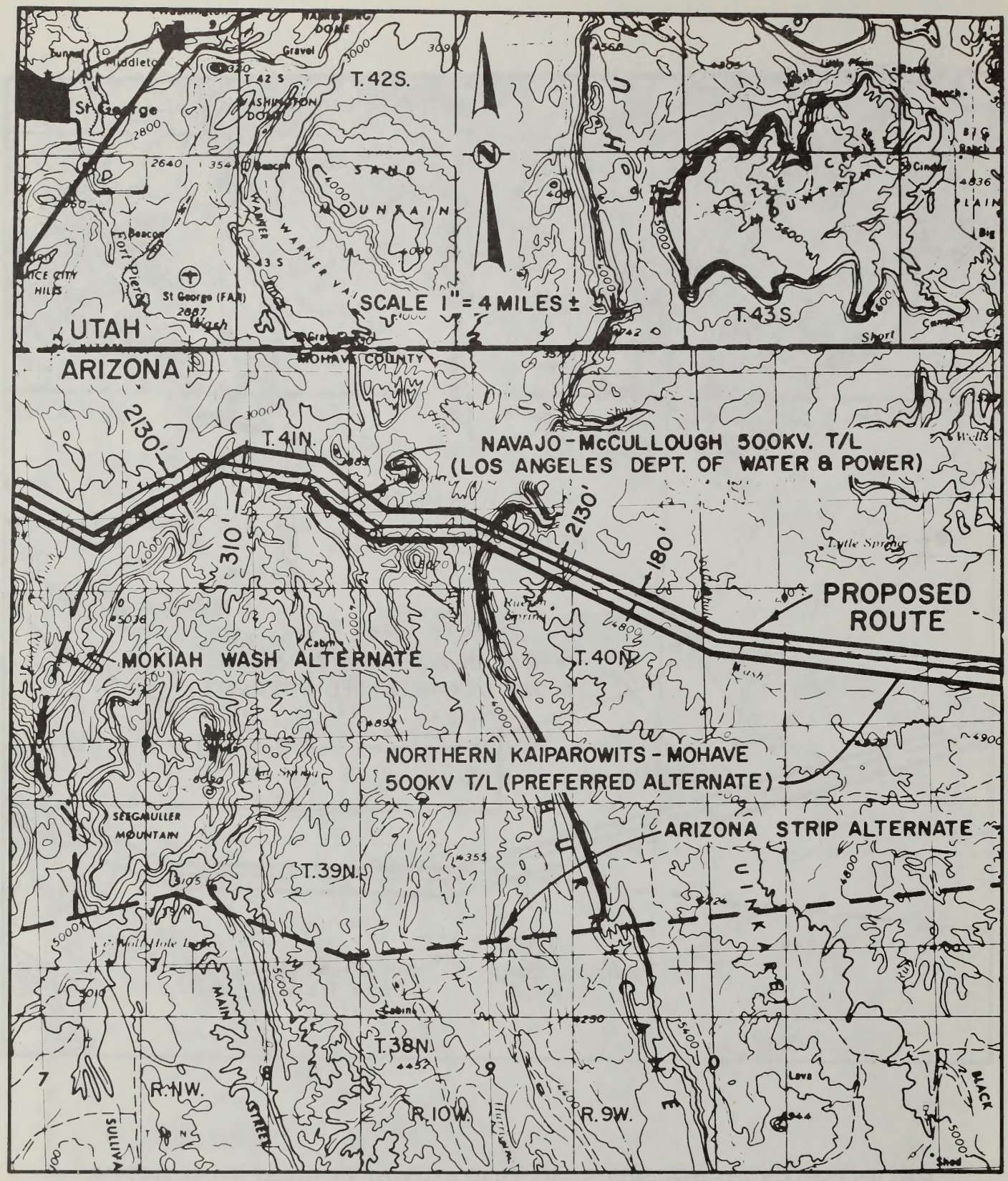
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ILLUSTRATION 16D



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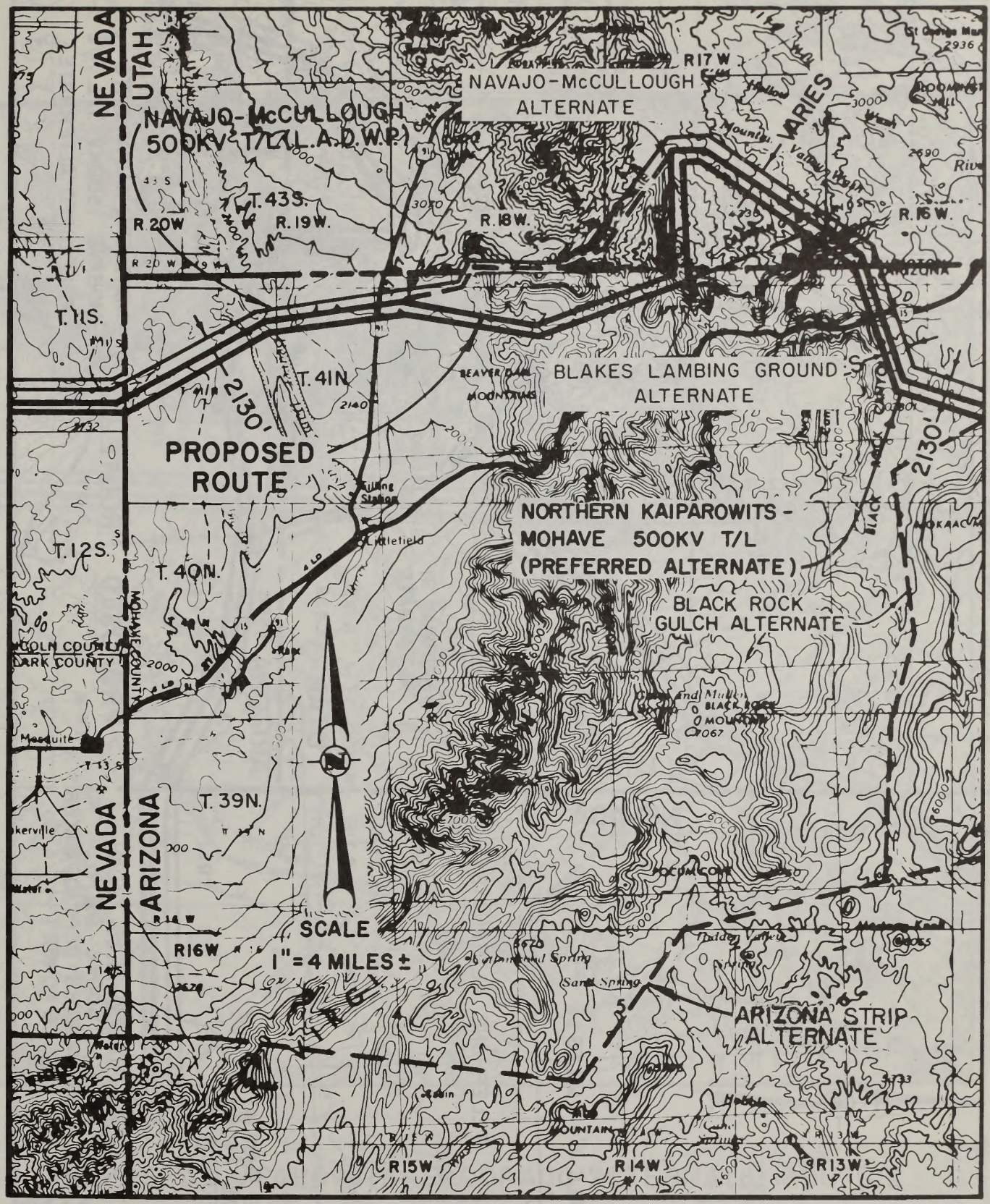
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ILLUSTRATION 16 E



PROPOSED KAIPAROWITS-ELDORADO ALTERNATE ROUTES

NORTHERN KAIPAROWITS-MOHAVE 500KV T/L

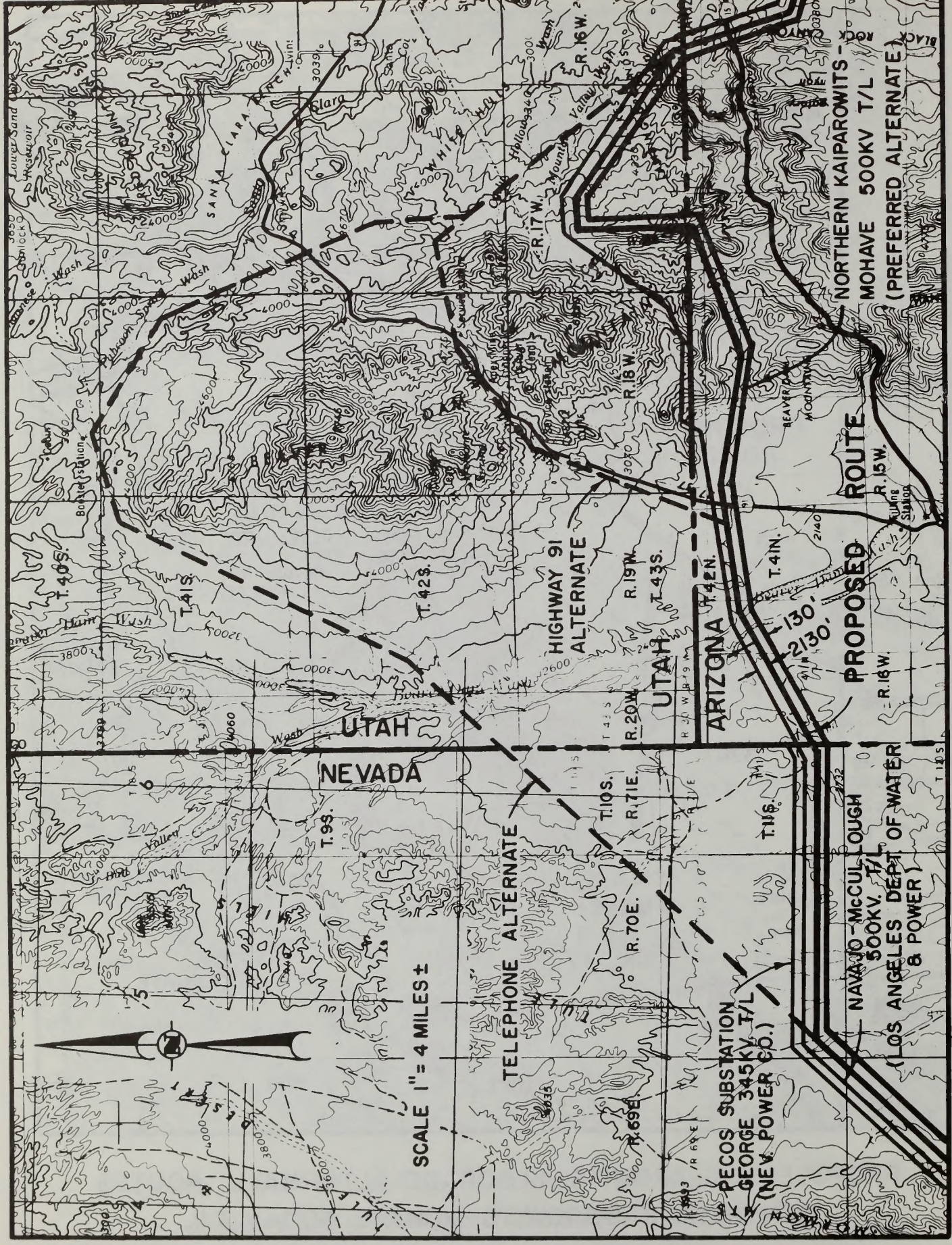
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AND ALTERNATE ROUTES

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ILLUSTRATION 16 F



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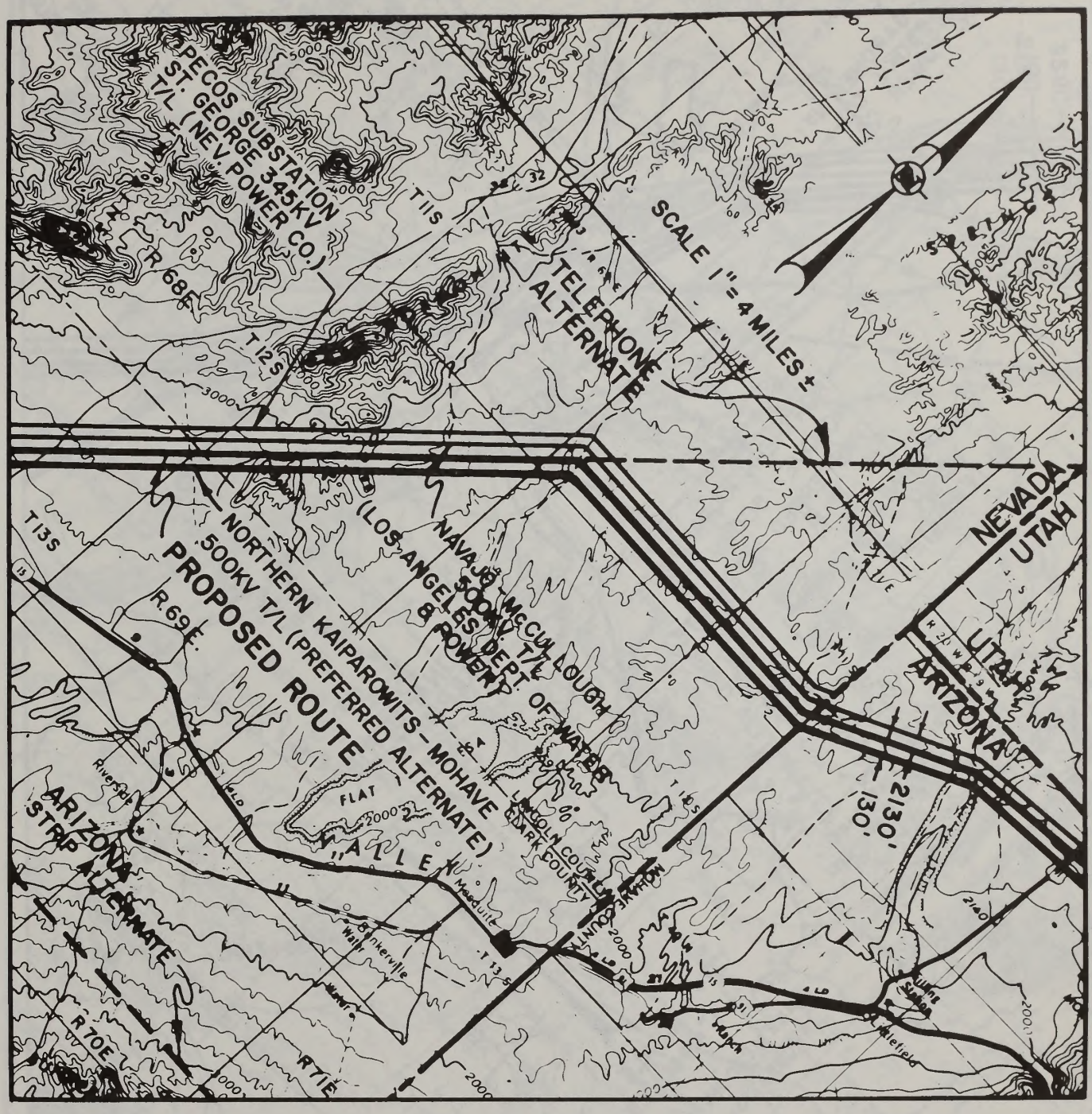
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ILLUSTRATION 16 G



PROPOSED KAIPAROWITS–ELDORADO ALTERNATE ROUTES

NORTHERN KAIPAROWITS-MOHAVE 500KV T/L

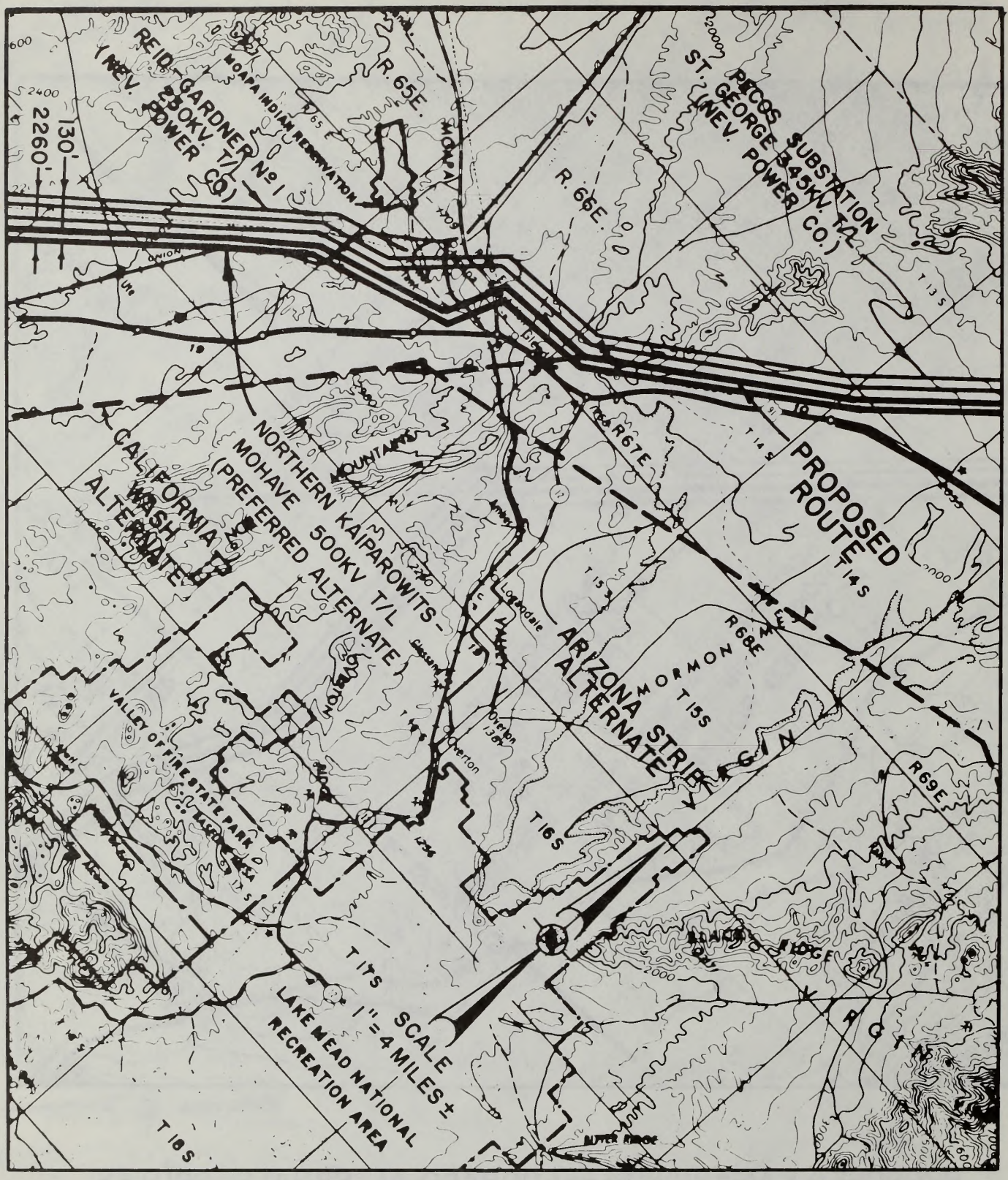
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AND ALTERNATE ROUTES

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ILLUSTRATION 16 H



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NORTHERN KAIPAROWITS-MOHAVE 500KV T/L

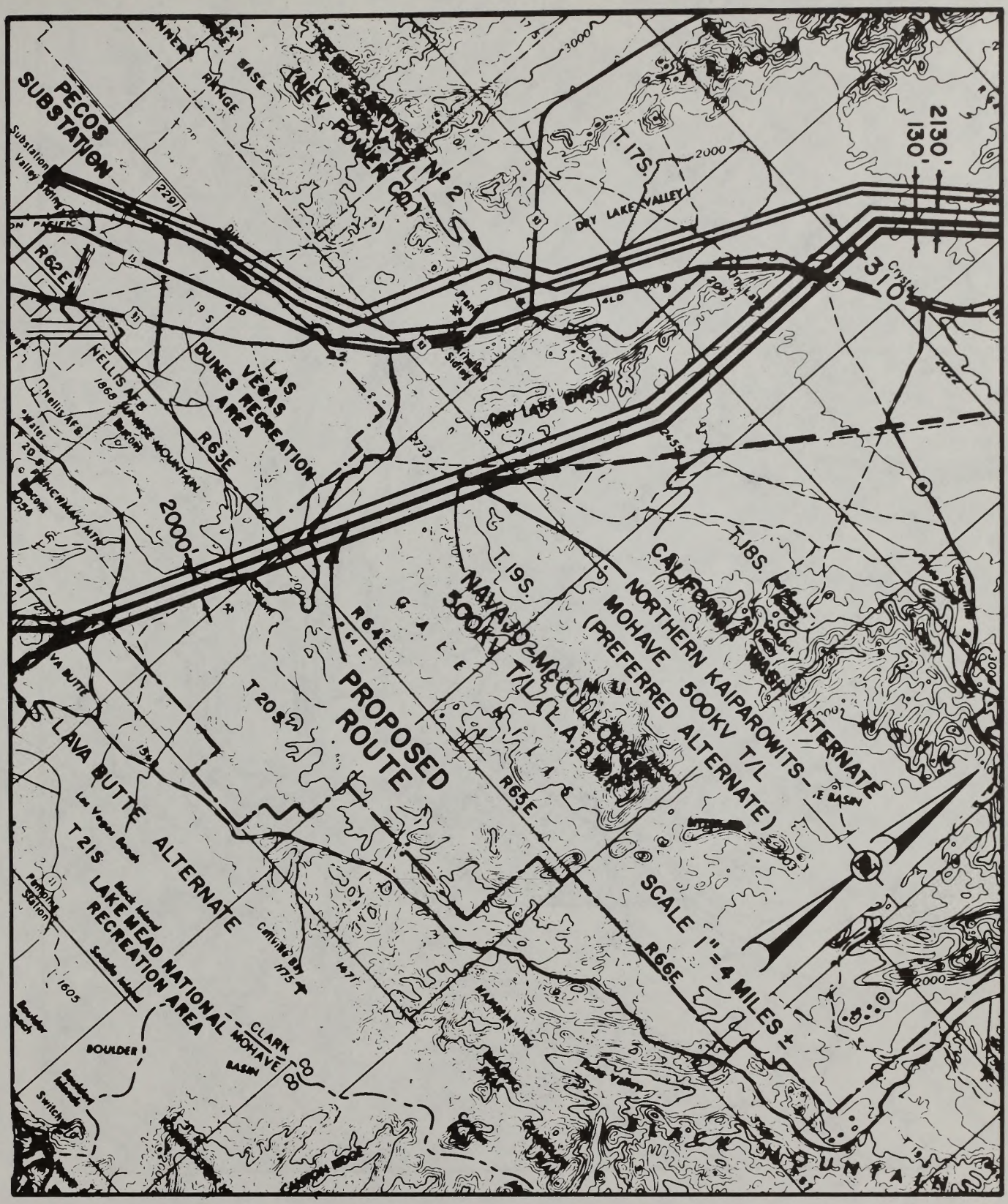
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AND ALTERNATE ROUTES

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ILLUSTRATION 16 I



PROPOSED KAIPAROWITS–ELDORADO ALTERNATE ROUTES

NORTHERN KAIPAROWITS-MOHAVE 500KV T/L

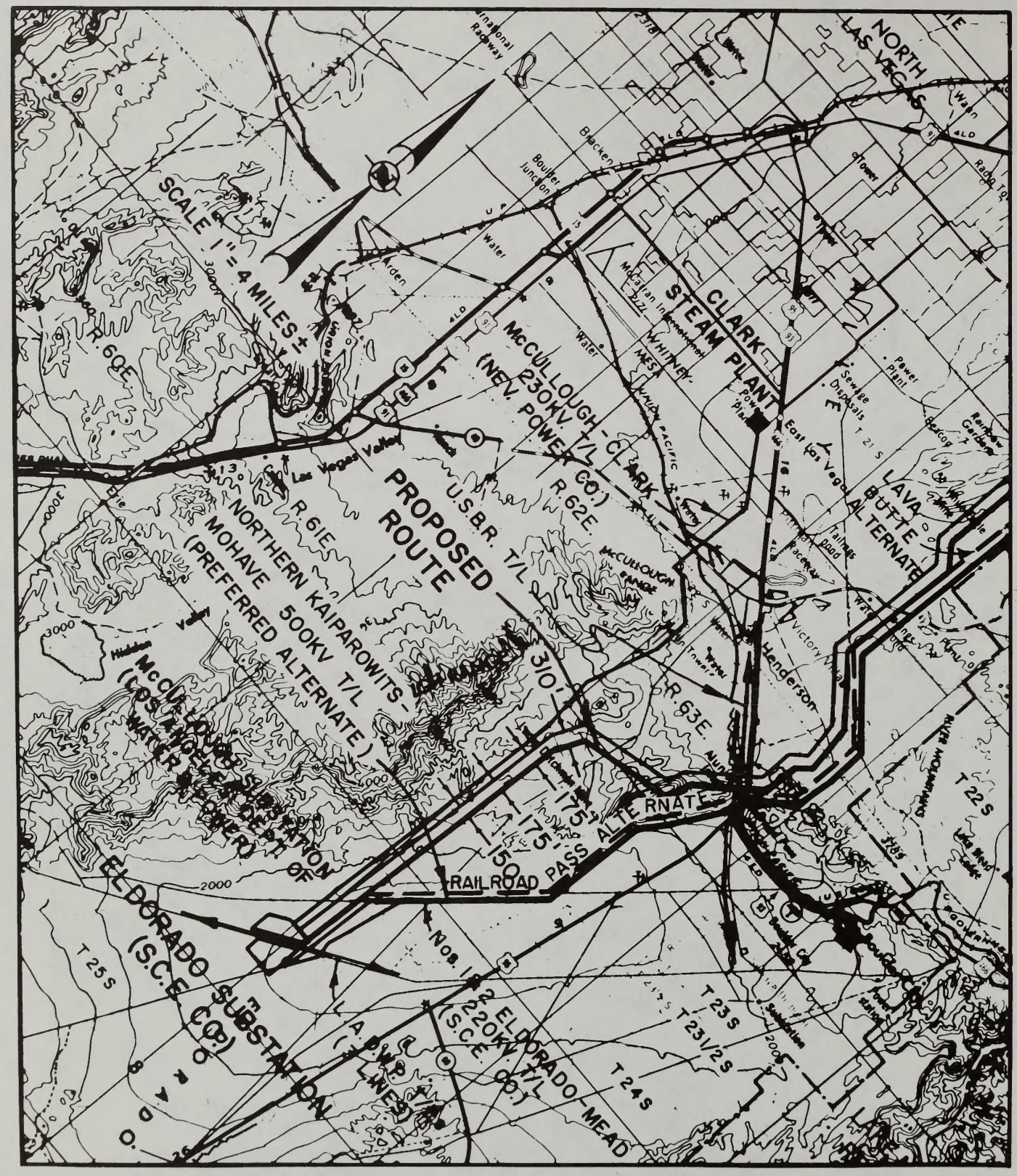
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AND ALTERNATE ROUTES

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ILLUSTRATION 16 J



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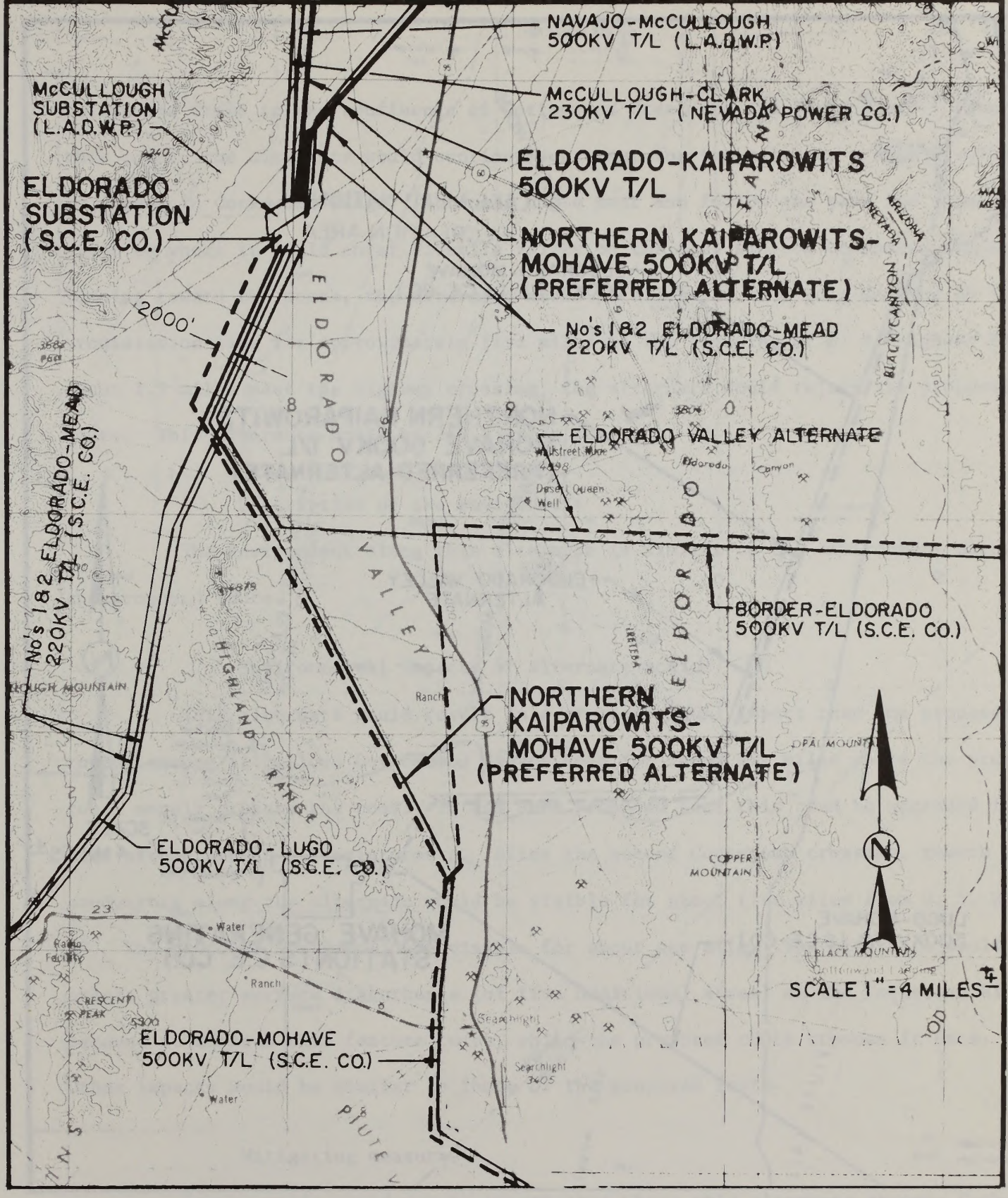
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AND ALTERNATE ROUTES

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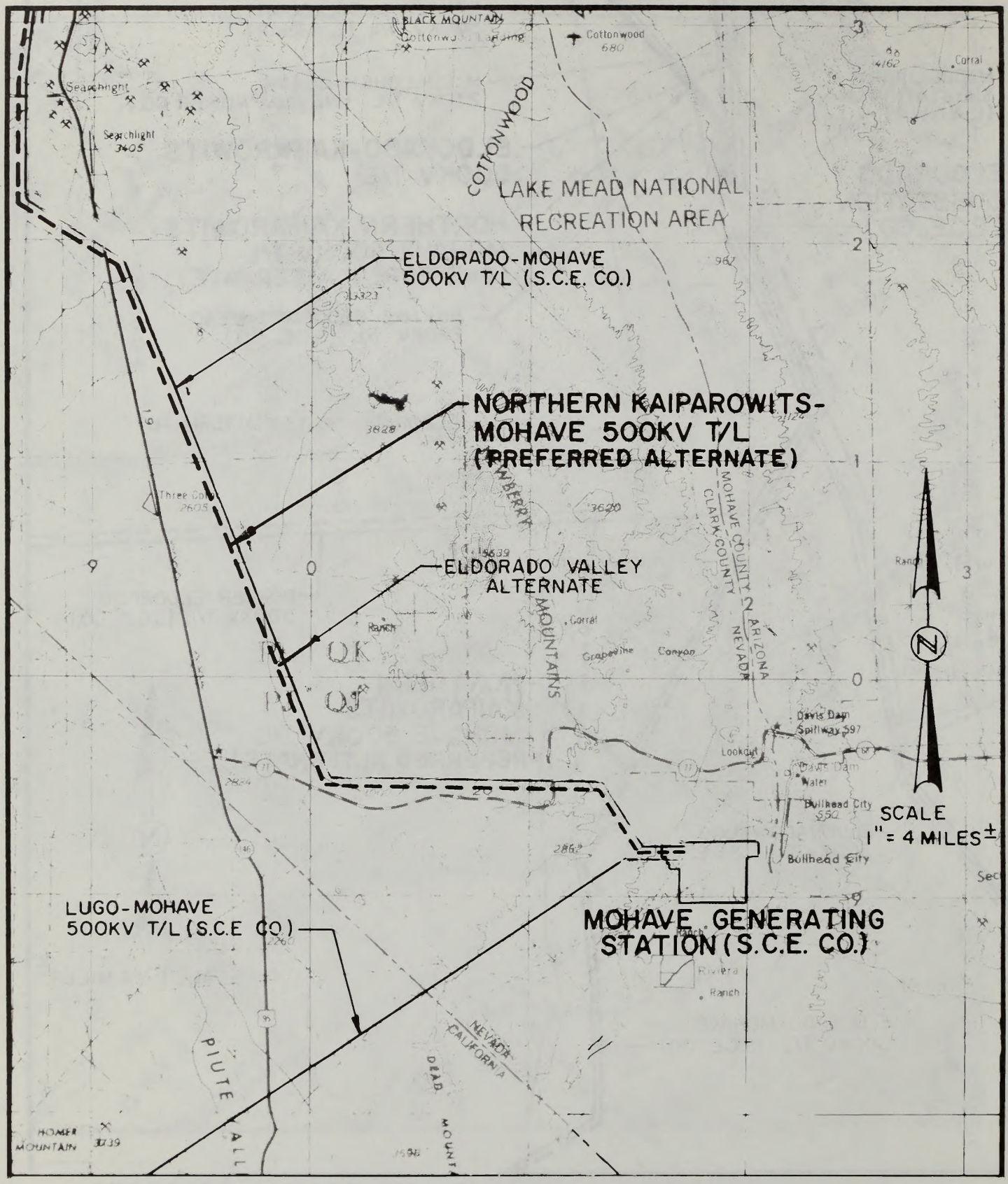
ILLUSTRATION 16 K



PROPOSED KAIPAROWITS-ELDORADO ALTERNATE ROUTES
NORTHERN KAIPAROWITS-MOHAVE 500KV T/L
PREFERRED ALTERNATE, AND
ARIZONA STRIP 500KV T/L PREFERRED ALTERNATES
AND ALTERNATE ROUTES

4-7-75

ILLUSTRATION 16 L



PROPOSED KAIPAROWITS-ELDORADO ALTERNATE ROUTES
NORTHERN KAIPAROWITS-MOHAVE 500KV T/L
PREFERRED ALTERNATE, AND
ARIZONA STRIP 500KV T/L PREFERRED ALTERNATES
AND ALTERNATE ROUTES

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ILLUSTRATION 16 M

Cottonwood Creek to the confluence of Cottonwood Creek and the Paria River. From this point, the alternate would continue southeast for two miles up a narrow valley to a pass in Cockscomb Ridge. It would angle west and follow the pass for about 1.2 miles to where it would enter Fivemile Valley on the west side of Cockscomb Ridge. Turning toward the south, the alternate would parallel the wood pole Garkane 69 kv transmission line for approximately five miles to the crossing of U. S. Highway 89. About 1.2 miles past the highway crossing, the alternate would rejoin the proposed route. This alternate would be 269.5 miles long.

Description of the environment

The environment along this alternate is similar to the environment along the proposed route.

Environmental impacts of alternate action

This alternate would result in a greater visual impact than the proposed route because it follows Cottonwood Canyon Road for about six miles while the proposed route merely crosses the road. It has been proposed that this road be upgraded for year around use as a tourist route. After the second Cockscomb crossing, towers and conductors along the alternate would be visible for about five miles from U. S. Highway 89. The proposed route would be visible for about one mile. The alternate would create greater surface disturbance (of five additional acres) on the Cockscomb Ridge because it crosses this feature twice, while the proposed route crosses it once. Other impacts would be similar to those of the proposed route.

Mitigating measures

Access roads would not be constructed where this alternate crosses Cockscomb Ridge. This measure would decrease the amount of surface disturbance.

Any adverse effects which cannot be avoided should the alternate be implemented

This alternate would result in greater visual impacts than the proposed

route because it follows Cottonwood Canyon for six miles and it would be visible from Highway 89 for five miles.

Cottonwood Paria alternate

Description of alternate action

This alternate would follow the Fivemile Canyon alternate route for 18 miles to an angle point one-quarter mile north of the confluence of Cottonwood Creek and the Paria River. From here the alternate would angle to the south for two miles along the Paria River and would be adjacent to the Utah Power and Light 230 kv transmission line and would rejoin the proposed route. After 2.4 miles, the alternate again would diverge from the proposed route in a more southerly direction traversing the lower elevations east of the Cockscomb for about three miles. After crossing Higway 89 the alternate would continue south for another mile and then turn southwest for 1.3 miles over the southern end of the Cockscomb and would rejoin the proposed route. This alternate would be 270 miles long.

Description of the environment

That portion of the alternate running along Cottonwood Creek and the Paria River follows two existing wood pole lines. This area contains unusual geologic features of high scenic quality. Other environmental values would be the same as the proposed route.

Environmental impacts of alternate action

This alternate would result in the same impacts in Cottonwood Canyon as the Fivemile Valley alternate. The Cottonwood-Paria alternate and the proposed route both would be skylined where they cross Cockscomb Ridge south of Highway 89; however, the alternate would be more visible than the proposed route. All other impacts along the alternate would be similar to the proposed route.

Mitigating measures

Mitigating measures would be the same as those for the proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

This alternate would produce visual impacts in Cottonwood Canyon and on Cockscomb Ridge near Highway 89. While the proposed route and alternate cross the same general area, the proposed route would not be as visible as the alternate. Otherwise, impacts would be similar to the proposed route.

East Clark Bench alternate

Description of alternate action

From the northwest corner of the Kaiparowits Generating Station, this alternate would run southwest and south for 4.6 miles across Fourmile Bench and would diverge from the proposed Kaiparowits to Moenkopi to Mohave route. At this point the alternate would drop off the bench into Smith Run and would continue southwest for 3.4 miles crossing the canyon diagonally, and then would rise to a low bench that separates Wahweap Creek from Smith Run. Turning south for 1.5 miles, the alternate would drop off the bench and cross to a high point on the west bank of Wahweap Creek. It then would proceed southeast for 2.5 miles, and would parallel the creek channel along the base of Jack Riggs Bench. The alternate would then swing around the base of Jack Riggs Bench for 1.6 miles and proceed west-southwest for 4.5 miles. At this point the alternate would turn southwest for four miles, turn due west for about five miles and would rejoin the proposed route about one-half mile north of Highway 89. This alternate would be about 270 miles long.

Description of the environment

Topography along this alternate is not as rugged and scenic as topography along the proposed route. Soils are similar to the proposed route except between Wahweap Creek and the Paria River. Along this 15 mile stretch, the alternate would cross shallow soils and rock outcrops. The erosion hazard of these soils is moderate to high, and if disturbed, they have low potential for rehabilitation. The alternate

would cross about 10 miles of mule deer habitat from the plant site to the edge of Fourmile Bench. The alternate would also cross the north edge of crucial pronghorn antelope winter range on East Clark Bench.

Environmental impacts of alternate action

By crossing about 15 miles of soils with moderate to high susceptibility to erosion and low rehabilitation potential, this alternate could cause an increase in suspended sediment in the Paria River. It is estimated that disturbance of these soils would cause sediment-yield of soils in the area to increase a maximum of one acre-foot the year following completion of construction. If this sediment (about 2,400 tons) was carried to the Paria River, the sediment load in the river would increase about .03 percent. This increase would not have a measureable effect on water quality or aquatic wildlife.

Since it crosses about 17 fewer miles of mule deer habitat than the proposed route, this alternate would not have as great an impact on mule deer. However, this alternate could result in a cumulative impact whereby antelope could be disturbed by construction activities on the east (Kaiparowits to Phoenix) and north sides of their winter range; such activities on two sides could prevent the antelope from using this range. In addition, improved access on two sides could increase the incidence of poaching.

Mitigating measures

All access roads would be obliterated and closed to travel between Wahweap Creek and the Cottonwood Canyon Road. This would prevent further disturbance of unstable soils after completion of construction, and would restrict access to antelope winter range.

Any adverse effects which cannot be avoided should the alternative be implemented

Since it crosses 15 more miles of sensitive soils than the proposed route,

this alternate would result in greater impacts on soils. This alternate would not have as much impact on mule deer because it crosses 17 fewer miles of their habitat than the proposed route. However, construction activities on the north and east sides of East Clark Bench could prevent antelope from using crucial winter range.

Flat Top alternate

Description of alternate action

This alternate would follow the East Clark Bench alternate to the point where it diverges west from the Kaiparowits to Moenkopi to Mohave route. From here the Flat Top alternate would parallel the Kaiparowits to Moenkopi to Mohave route at a 200 foot separation for 21 miles to an angle point adjacent to but north of the LADWP Navajo-McCullough line. The alternate would follow the Navajo-McCullough line for 16 miles, again on a 200 foot separation, and would rejoin the proposed Kaiparowits to Eldorado route at the south end of the Cockscomb. This alternate would be 279 miles long.

Description of the environment

In most cases, topography along this alternate is not as rugged and scenic as topography along the proposed route. Exceptions are an area of balanced rocks along Wahweap Creek several miles north of Glen Canyon City, and the Paria Canyon Primitive Area.

Soils along this route are fairly stable, and are not as susceptible to erosion as soils along the proposed route. In addition, soils along this alternate have a slightly higher potential for rehabilitation. This alternate crosses mule deer habitat similar to that for the East Clark Bench alternate. The pronghorn antelope habitat on East Clark Bench was described for the Kaiparowits Plateau Impact Area.

Environmental impacts of alternate action

Soils and vegetation along this alternate would undergo higher impacts than

along the proposed route because the alternate would create about nine more miles of new corridor. This would amount to about 16 more acres of soils and vegetation disturbed. However, soils along this alternate are more amenable to rehabilitation. Mule deer along this alternate would undergo impacts similar to those described for the East Clark Bench alternate. The Flat Top alternate would also result in the same impacts on antelope as the proposed Kaiparowits to Phoenix route.

Visual vulnerability of this alternate would be greater than the proposed route because it would be visible from the proposed townsite. Scenic values along the alternate are generally lower, with the exceptions of the area of balanced rocks and the Paria Canyon Primitive Area. Scenic impacts along this alternate would be less than the proposed route because the alternate would cross only a few miles of scenic areas whereas the proposed route would cross about 15 miles. In addition, the alternate would not be as visible at its Highway 89 crossing as the proposed route would at its Highway 89 crossing.

Mitigating measures

Supporting towers at the Paria Canyon crossing would be located so that they would not be visible from the bottom of the canyon. This would reduce the visual impact of another transmission line crossing the Paria River Canyon.

Any adverse effects which cannot be avoided should the alternate be implemented

Although it would not result in visual impacts as great as those resulting from the proposed route, this alternate would still produce visual impacts in the two small areas of unique scenery described above.

Mokiah Wash alternate

Description of alternate action

This alternate would turn south from the proposed route about 12 miles west of Hurricane Cliffs and would follow Mokiah Wash for 11 miles to the edge of Seegmuller

Mountain. At this point the alternate would meet the route of the Arizona Strip Proposal. The alternate would then follow this route west until it connects with the California Wash alternate near Glendale, Nevada. The alternate would then follow the California Wash alternate southwest for 25 miles and would rejoin the proposed Kaiparowits to Eldorado route. The Mokiah Wash alternate would be 262 miles long.

Description of the environment

The environment along this alternate is generally the same as the environment along the proposed route, the Arizona Strip proposal, and California Wash Alternate. An exception is that the Mokiah Wash alternate would cross about eight more miles of pinyon-juniper woodland than the Arizona Strip proposal.

Environmental impacts of alternate action

The Mokiah Wash alternate would also result in a greater impact on the pinyon-juniper woodland community because it crosses eight more miles of this community than the Arizona Strip proposal. Although the Mt. Trumbull Road could be used for access along Mokiah Wash, the alternate would reduce scenic quality as viewed from the road. This alternate could also result in a greater impact on archaeological values because it would add 78 more miles of new corridor.

Mitigating measures

Mitigating measures for the proposed route, Arizona Strip proposal, and California Wash apply to the Mokiah Wash alternate.

Any adverse effects which cannot be avoided should the alternate be implemented

Unavoidable adverse impacts would generally be the same as for the proposed route, Arizona Strip proposal, and California Wash alternate. In addition, the Mokiah Wash alternate would result in disturbance of eight more miles of pinyon-juniper woodland than the Arizona Strip proposal, reduced visual quality along the Mt. Trumbull Road, and possible loss of archaeological values along 78 miles of new corridor.

Black Rock Gulch alternate

Description of alternate action

About 15 miles past Hurricane Cliffs, this alternate would depart from the proposed route in a southwest direction along the base of Mokiah Mountain. After 3.6 miles the alternate would turn south and follows Black Rock Gulch for 11.4 miles to the Arizona Strip route. This alternate would be identical to the Mokiah Wash alternate from here on. The Black Rock Gulch alternate would be 267 miles long.

Description of the environment

The environment along this alternate is simlar to the environment along the Mokiah Wash alternate.

Environmental impacts of alternate action

Environmental impacts of this alternate would be similar to those discussed for the Mokiah Wash alternate.

Mitigating measures

Same as the proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

Adverse impacts would be the same as for the Mokiah Wash alternate.

Navajo - McCullough alternate

Description of alternate action

This alternate would leave the proposed route on the east side of Beaver Dam Mountains. It follows the existing Navajo-McCullough transmission line through Bulldog Canyon to Old Highway 91 and would rejoin the proposed route west of the mountains. This alternate would be about 267 miles long.

Description of the environment

Vegetation is the same as along the proposed route, except that the alternate

crosses about four miles of pinyon-juniper woodland community in the Beaver Dam Mountains.

The alternate route would cross Gambel's quail habitat in the Beaver Dam Mountains; however, this is not crucial habitat like that along the proposed route. Furthermore, quail habitat along the alternate has already been disturbed by the Navajo-McCullough transmission line.

This alternate would follow a utility corridor established through Bureau of Land Management planning. The proposed route would diverge from this corridor in the Beaver Dam Mountains. The purpose of such a corridor is to meet needs for utility rights-of-way and at the same time preserve natural values of other lands.

Environmental impacts of alternate action

Quail habitat along this alternate has already been disturbed because it is an existing corridor; another line would probably have little effect on quail. Conversely, the proposed route would cross undisturbed, crucial Gambel's quail habitat. In addition, the alternate would create 12 fewer miles of new corridor than the proposed route.

Mitigating measures

Mitigating measures are the same as for the proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

Disturbance of quail habitat would not be as great along the alternate because it would follow an existing corridor. About 26 acres of quail habitat would be permanently disturbed by the alternate, but this habitat is not crucial to Gambel's quail.

Highway 91 alternate

Description of alternate action

This alternate would leave the proposed route near Blake's Lambing Ground

and cross the foothills of the Beaver Dam Mountains in a northwest direction for nine miles. The alternate would then turn west southwest for three miles and cross old Highway 91 in the mountains. It would then turn southwest and follow this highway for about 10 miles before rejoining the proposed route a few miles west of the Beaver Dam Mountains. This alternate would be 271 miles long.

Description of the environment

Highway 91 was a major transportation route, but it has been replaced by I-15 further to the south. The highway is still used by some travellers as a sight-seeing route.

This alternate route passes through three miles of the Joshua Tree Natural Area, which was established for desert tortoise and Joshua trees in the southwest corner of Utah. The area represents the northern limit of the desert tortoise range and is crucial habitat. In addition, it is the only known desert tortoise habitat in Utah.

At the top of the Beaver Dam Mountains this alternate crosses a pass between two potential desert bighorn sheep reintroduction areas; if reintroduced to these areas, bighorn sheep would probably use the pass as a migration route. This pass is also a migration route between two crucial mule deer winter ranges.

Environmental impacts of alternate action

This alternate would reduce scenic quality of part of the Beaver Dam Mountains and areas along Old Highway 91. Since the alternate would create about nine more miles of new corridor than the proposed route, it would result in about 19 more acres of soil and vegetation permanently disturbed.

This alternate route would probably have little effect, if any, on the migration of desert bighorn sheep if they were reintroduced to the Beaver Dam Mountains. Construction of the line during winter months (November through February) could restrict or alter the normal migration of mule deer through the pass in the

Beaver Dam Mountains. The alternate would reduce natural values and disturb crucial desert tortoise habitat in the Joshua Tree Natural Area. Impacts on raptors, Gambel's quail, and Gila monsters would be much less along the alternate than along the proposed route because the alternate would not cross habitat crucial to these wildlife species.

Mitigating measures

1. Access roads from Highway 91 to the alternate would be obliterated where the alternate crosses Joshua Tree Natural Area in southwest Utah. This would avoid permanent improvement of access to desert tortoise habitat.

2. Construction in the Beaver Dam Mountains would be limited to the period March through October. This would insure that mule deer would be able to migrate to winter range.

Any adverse effects which cannot be avoided should the alternate be implemented

This alternate would reduce scenic and natural values along undisturbed land in the Beaver Dam Mountains and the Joshua Tree Natural Area. The alternate would also temporarily disturb desert tortoise habitat in the natural area.

Telephone alternate

Description of alternate action

This route would follow the Highway 91 alternate for about eight miles. From there it would continue north and northwest for about 14 miles to the north end of the Beaver Dam Mountains. The alternate would then turn west southwest across the north end of the mountains for three miles and then southwest for 26 miles to rejoin the proposed route east of the Mormon Mountains. This route would be 286 miles long.

Description of the environment

Topography along this alternate is flatter than along the proposed route because the alternate goes around Beaver Dam Mountains rather than across them. The

alternate would skirt mule deer habitat and potential desert bighorn sheep habitat along the mountains. It would also cross a mule deer migration route between these mountains and the Red Mountains. This alternate would cross desert tortoise habitat between the north end of the Beaver Dam Mountains and the point where it rejoins the proposed route.

There is potential for archaeological and historical sites along this alternate, especially in the vicinity of Beaver Dam Wash. Although specific sites are not identified, there is always potential in undisturbed areas.

The alternate would cross the Shivwits Indian Reservation which is located about 10 miles northwest of St. George. About six miles of the route would be on the reservation.

Environmental impacts of alternate action

It is estimated 15 more acres of soil and vegetation would be permanently disturbed along this alternate than along the proposed route. In addition, the erosion hazard of disturbed soils along this alternate could be high as compared to medium for the proposed route.

Construction activities and improved access to areas adjacent to the Beaver Dam Mountains could result in increased poaching of mule deer, harrassment of desert tortoise, and loss of unidentified archaeological and historical values.

This alternate could remove about 40 acres of the Shivwits Indian Reservation from present uses which consist of grazing and farming rights leased to ranchers. This could eliminate these lands as a source of revenue for the Indians; however, fees paid by the participants would probably offset these losses. The significance of any other losses would probably be best determined by the Indians.

Mitigating measures

Mitigating measures would be the same as for the proposed action.

Any adverse effects which cannot be avoided should the alternate be implemented

This alternate would result in permanent disturbance of about 15 more acres of soil and vegetation than the proposed route. By improving access in a large area, the alternate could cause an increase in harrassment of mule deer and desert tortoise, but, impacts on wildlife caused by this alternate would be much less than those impacts resulting from the proposed route. Improved access could also result in losses of archaeological and historical values, especially in the area near Beaver Dam Wash.

Blake's Lambing Ground alternate

Description of alternate action

This alternate route would leave the proposed route east of Beaver Dam Mountains, cross Blake's Lambing Ground for 3.6 miles and then rejoin the proposed route. This alternate would be about 265 miles long.

Description of the environment

This alternate would avoid crucial Gambel's quail habitat in Cedar Wash. In all other respects, the alternate is similar to the proposed route.

Environmental impacts of alternate action

Impacts resulting from this alternate would be similar to the proposed route except the alternate would not cross the crucial quail habitat described above.

Mitigating measures

Mitigating measures would be the same as the proposed action.

Any adverse effects which cannot be avoided should the alternate be implemented

Adverse effects along this alternate would be the same as environmental impacts described above.

California Wash alternate

Description of alternate action

This alternate would follow the proposed route for 192 miles to an angle point northeast of Glendale, Nevada. From here, the alternate would continue southwest for 3.5 miles and cross Interstate 15 about one mile east of Glendale. It would pass about 4,800 feet southeast of the Glendale airstrip and would cross the Muddy River to high ground on the south side of the river. The route would continue southwest to the Arizona Strip alternate and follow this alternate for 2.5 miles. The California Wash alternate would then turn southwest for about 22 miles, leaving Interstate 15 and following a buried AT&T telephone cable. The alternate would then rejoin the proposed Kaiparowits to Eldorado route east of the Dry Lake Range. This alternate would be 262 miles long.

Description of the environment

The environment is nearly the same along California Wash as along the proposed route with the exception of archaeological values. The same general types of sites and artifacts have been found along both routes; however, it is likely that a denser concentration of sites and artifacts would occur along the alternate.

Environmental impacts of alternate action

The California Wash alternate could result in greater impacts on archaeological values than the proposed route because of the likelihood of a denser concentration of sites along California Wash. The alternate would follow a right-of-way for a buried telephone cable which could provide access to the alternate. The alternate would create a new transmission line corridor that would result in reduced visual quality for about 10 miles east of I-15. The proposed route would follow the existing corridor west of I-15 for a similar distance

Mitigating measures

Same as the proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

Unmitigated impacts would be the potential loss of archaeological data along California Wash and the visual impacts caused by 28 miles of new transmission line corridor a few miles east of I-15.

Lava Butte alternate

Description of alternate action

This route would follow the proposed route for about 239 miles and would then angle due south for about two miles along the east slope of Lava Butte. It would then turn southwest for approximately one mile and rejoin the proposed route on the north side of Las Vegas Wash. This alternate would be 269 miles long.

Description of the environment

The area along the east slope of Lava Butte is an undisturbed area with relatively high natural values. The alternate route would be adjacent to the west boundary of the Lake Mead Recreation Area.

Environmental impacts of alternate action

This alternate would result in a higher impact on scenic and natural values than would the proposed route. Although the proposed route would reduce scenic quality as viewed from the Rainbow Gardens Area, existing lines have already reduced scenic quality from this area. The alternate would constitute three miles of new intrusion visible from Las Vegas Beach on Lake Mead.

Mitigating measures

Mitigating measures are the same as those for the proposed route.

Any adverse effects which cannot be avoided should the alternative be implemented

The alternate would reduce scenic and natural values of three miles of undisturbed land along the east side of Lava Butte. This area would be visible from Las Vegas Beach on Lake Mead.

Railroad Pass alternate

Description of alternate action

This route would follow the proposed route for 247 miles to the outskirts of the city of Henderson at the base of the River Mountains. From there the route would angle southwest from the proposed route for 2.6 miles, head up a draw in the foothills generally follow an existing powerline. The route would then bend south for 2.8 miles and cross a canyon area in the foothills. It would then turn west for about one-half mile, and descend the River Mountains to the floor of Las Vegas Valley one-half mile north of Railroad Pass. The alternate would turn southwest for about four miles through Railroad Pass and would cross Highway 93, the Union Pacific Railroad, a pipeline, and a transmission line, all of which cross the pass. The alternate would continue southwest along the foot of the Black Hills for three miles and then turn south for 2.5 miles across Eldorado Valley. At this point the alternate would turn southwest paralleling the SCE north and south Boulder Transmission lines. The alternate would follow these lines for five miles and then rejoin the proposed route two miles from Eldorado Substation. This alternate would be 269 miles long.

Description of the environment

The environment along this alternate is about the same as along the proposed route with two exceptions. The alternate would cross about 12 more miles of undisturbed land and a desert bighorn sheep migration route. The proposed route would parallel the same migration route.

Environmental impacts of alternate action

The alternate would restrict the migration of desert bighorn sheep much less than would the proposed route. Desert bighorn sheep have a greater tendency to cross rights-of-way such as roads, transmission lines, etc. at right angles rather than to migrate along them.

The alternate would create about 12 miles of new transmission corridor in

Las Vegas and Eldorado Valleys and it could eliminate part of Eldorado Valley as a potential site for an airport. The alternate would not be visible from Henderson as would the proposed route; however, the proposed route would not be an entirely new intrusion since it follows an existing line.

Mitigating measures

The mitigating measures would be the same as on the proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

This alternate could interfere with the migration of desert bighorn sheep, but not to the extent the proposed route would. This alternate could eliminate part of Eldorado Valley as a potential site for an airport.

Black Hills alternate

Description of alternate action

This alternate would follow the proposed route to Railroad Pass southeast of Henderson, Nevada. At this point the alternate would turn south and join the Railroad Pass alternate to Eldorado Substation. The Black Hills alternate would be about 268 miles long.

Description of the environment

The environment along this alternate is the same as the environment along the proposed route and the Railroad Pass Alternate.

Environmental impacts of alternate action

This alternate would combine some of the better features of the proposed route and the Railroad Pass alternate, while it would eliminate some of the more undesirable features of both. By following the proposed route to Railroad Pass, the alternate would have less impact than the Railroad Pass alternate on scenic and natural values and desert bighorn sheep in the River Mountains. The Black Hills

alternate would be visible for a few miles east of Henderson; however, it would follow an existing line which has already reduced scenic quality. This alternate would not restrict the migration of desert bighorn sheep as much as the proposed route south of Railroad Pass, or the Railroad alternate north of Railroad Pass, as they have a tendency to cross at right angles, rather than parallel.

The alternate would create about seven miles of new corridor, about five miles less than the Railroad Pass alternate. The Black Hills alternate could eliminate part of Eldorado Valley as a potential site for an airport.

Mitigating measures

Mitigating measures would be the same as those for the proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

The alternate could interfere with normal migration of desert bighorn sheep, but not as much as the proposed route or the northern half of the Railroad alternate route. The alternate could eliminate part of Eldorado Valley as a potential site for an airport.

Impact evaluation

An impact evaluation of all alternate transmission system routes for the Kaiparowits to Eldorado segment is contained in Figure 4.

Kaiparowits to Phoenix (Illustrations 17 to 17t)

John Henry alternate

Description of alternate action

This route would follow the proposed route for 5.2 miles, and then turn southeast for 2.3 miles. From there it would run along a finger of Fourmile Bench for 2.5 miles, and down a ridge into John Henry Canyon.

The route would then turn south, leaving John Henry Canyon, for 2.2 miles,

FIGURE 4

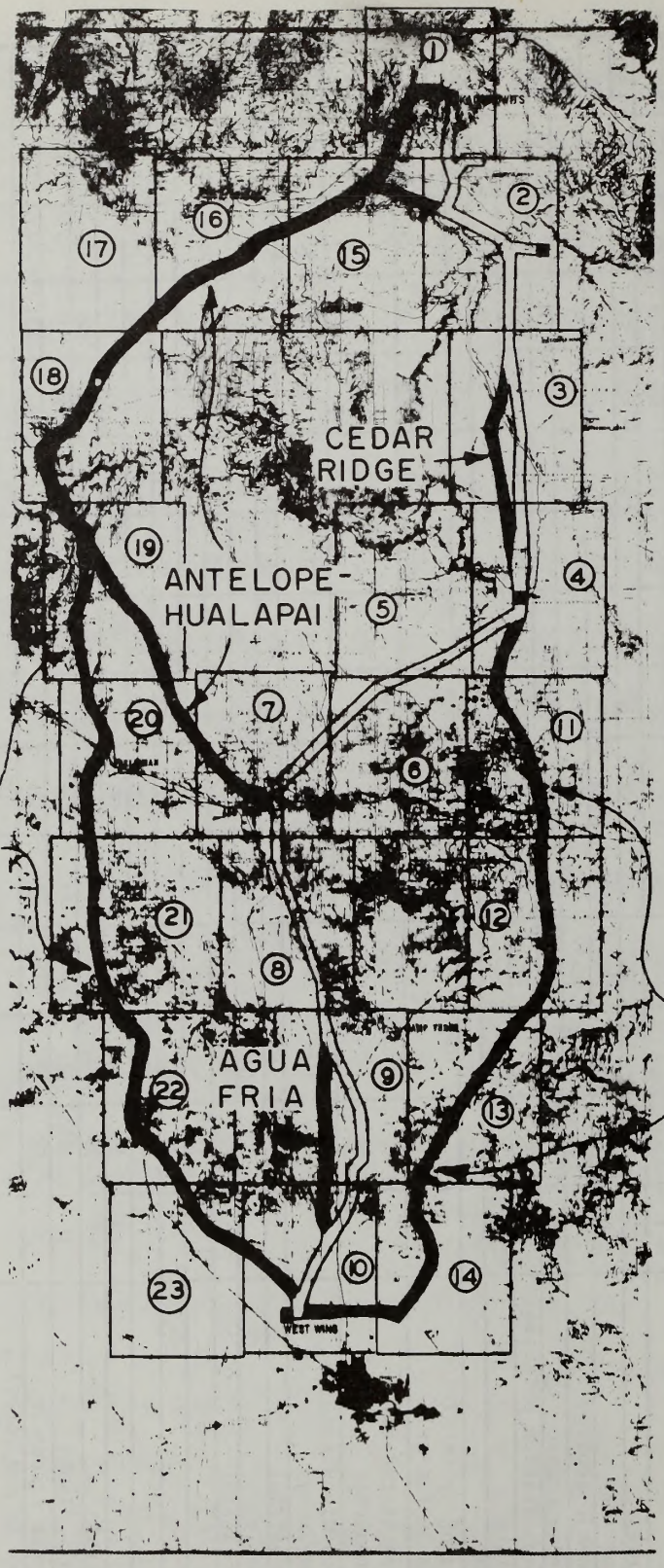
Impact Evaluation of Alternate Routes for Proposed Kaiparowits to Eldorado Route[a]

		Importance to decision making[b]	Fivemile Valley	Cottonwood-Paria	East Clark Bench	Flat Top	Mokiah Wash	Black Rock Culch	Navajo-McCullough	Highway 91	Telephone	Blake's Lambing Ground	California Wash	Lava Butte	Railroad Pass	Black Hills
Mileage (more or less than proposed route)		5	+1	+1	+1	+9	-7	-2	-2	+2	+7	-4	-7	0	0	-1
Climate		0	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Air Quality		1	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS
Geology and Topography	General	1	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS
	Seismology	0	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
	Economic geology	0	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Soils	Erosion hazard	5	MM	MS	MH	MS	MM	MM	SS	SM	MH	MM	SS	NN	NN	NN
	Rehabilitation potential[c]	5	SS	SS	MS	SM	MM	MM	MM	MS	MM	MM	SS	SS	SS	SS
Water Resources	Quality	5	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS
	Demand	7	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS
Vegetation	Grazing (potential loss of forage)	4	SS	SS	SS	SS	SM	SM	NN	SM	SM	SS	NN	NN	NN	NN
	Acres disturbed (permanent)	6	MM	MS	MM	MM	MH	MH	MS	SM	SM	MM	MM	SS	SS	SS
	Acres disturbed (temporary)	6	MM	MS	MM	MM	MH	MH	MS	SM	SM	MM	MM	SS	SS	SS
Wildlife	Terrestrial	9	MM	SS	MM	MS	MH	MH	HS	HS	HS	HS	HH	SS	HS	SS
	Aquatic	2	NN	NN	NN	NN	SS	SS	NN	NN	NN	SS	MM	NN	SS	SS
Ecological Interrelationships	Terrestrial	9	MM	SS	MM	MS	MH	MH	HS	HS	HS	HS	HH	SS	HS	SS
	Aquatic	2	NN	NN	NN	NN	SS	SS	NN	NN	NN	SS	MM	NN	SS	SS
Paleontology		2	SS	SS	SS	SS	SS	SS	NN	SS	SS	NN	SS	SS	SS	SS
Archaeology		8	MM	MM	MM	MM	MH	MH	NN	SS	SM	NN	SS	MM	SS	SS
History		6	MS	SS	SS	SS	MH	MH	NN	SS	SM	NN	SS	SS	SS	SS
Recreation	General	6	MM	MM	SS	MM	MH	MH	SS	SS	SS	MM	SS	MM	SS	SS
	Scenic values	10	MH	MH	HM	MS	MH	MH	MM	MM	MS	HH	MH	SM	SM	SS
	Natural values	9	MM	MM	MM	MM	MH	MH	MM	MM	SS	MM	MM	SM	SM	SS
Land Uses	Miles of new corridor (more or less than prop.)	9	-5	-6	0	+9	+78	+86	-12	+9	+39	0	+28	+3	+12	+7
	Wood Products	1	SS	NN	SS	SS	SM	SM	NN	NN	NN	NN	NN	NN	NN	NN
	Agriculture	1	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN	NN
Socio-Economic	Housing and services	1	MM	MM	MM	MM	MH	MM	MM	MM	MM	MM	MM	MM	MH	MH
	Culture and attitudes	1	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS

[a]Impacts rates as N-none; S-slight; M-medium; H-high - All alternates are compared to that part of the proposed route replaced by the alternate. The first letter indicates the impact each resource would undergo along the replaced segment of the proposed route. The Second letter indicates the impact each resource would undergo along the alternate where it deviates from the proposed route.

[b]Rated from 1 to 10 - This rating indicates the significance of each resource to decision making. Generally, ratings are based either on the degree to which a resource or activity would be impacted, or on the degree of potential controversy surrounding the resource or activity; the higher the rating, the higher the potential for impacts or controversy.

[c]This rating is not a comparison of impacts, but instead it is a comparison of rehabilitation potentials.

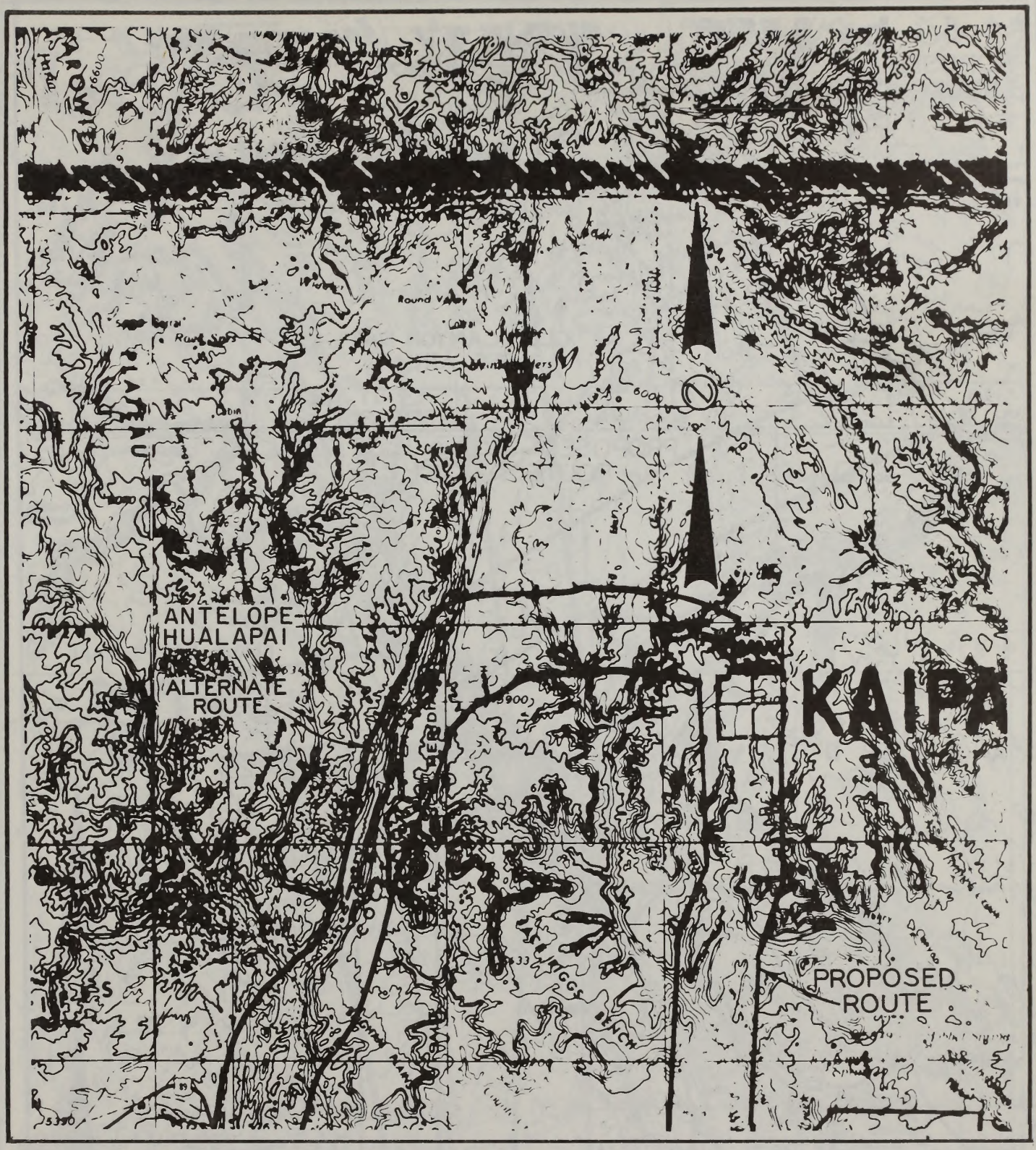


PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

4-18-75

INDEX MAP

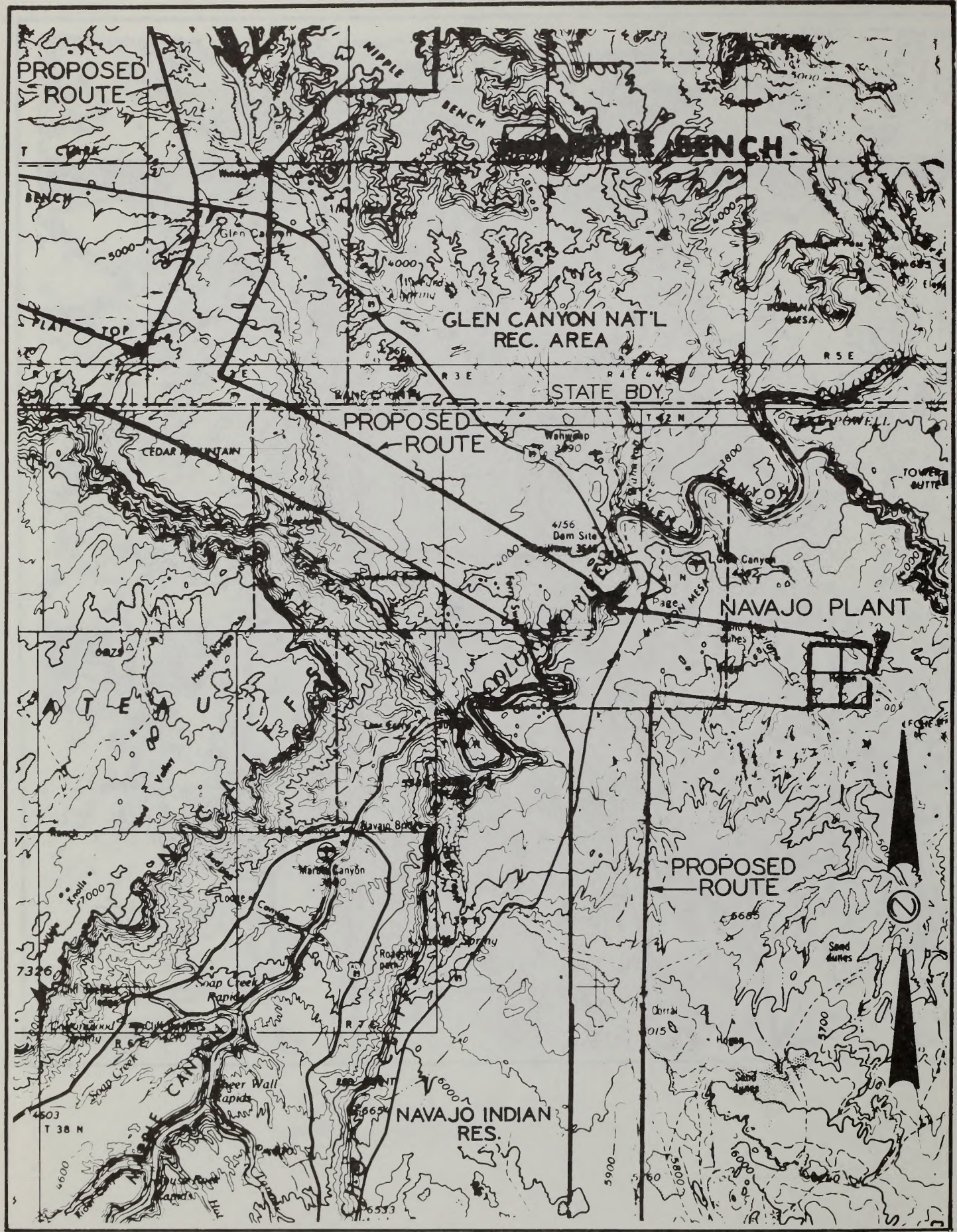
ILLUSTRATION 17



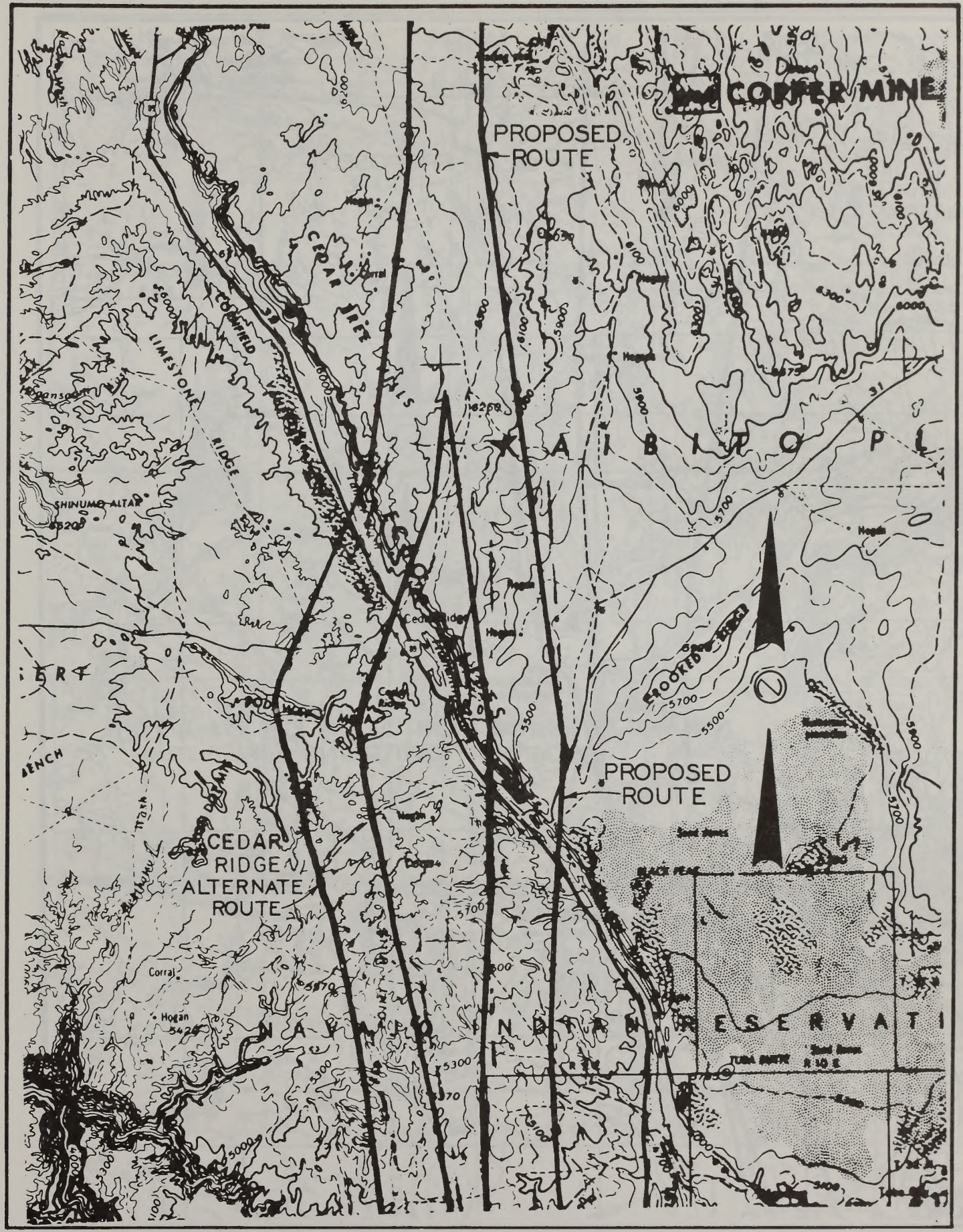
PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

4-18-75

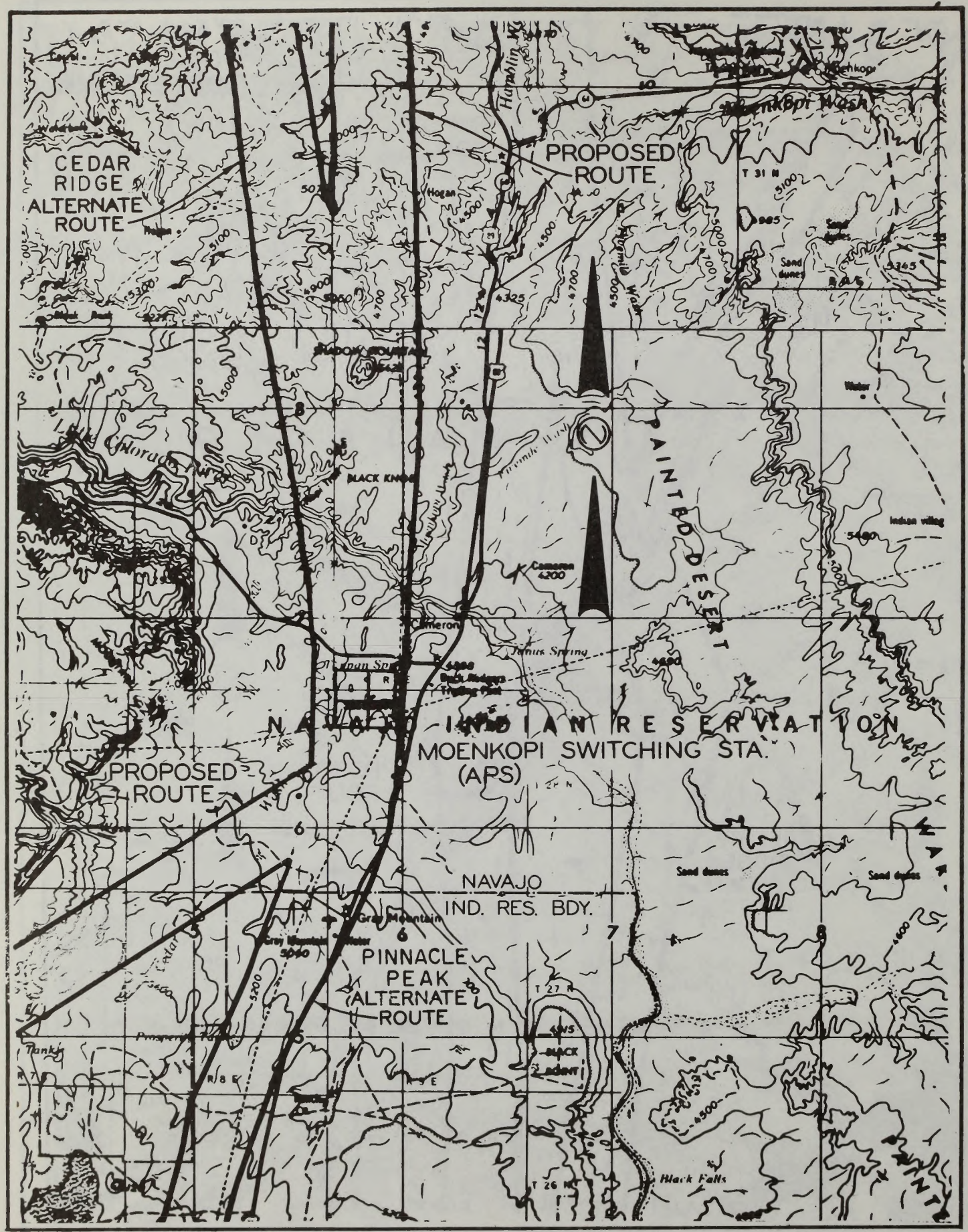
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PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

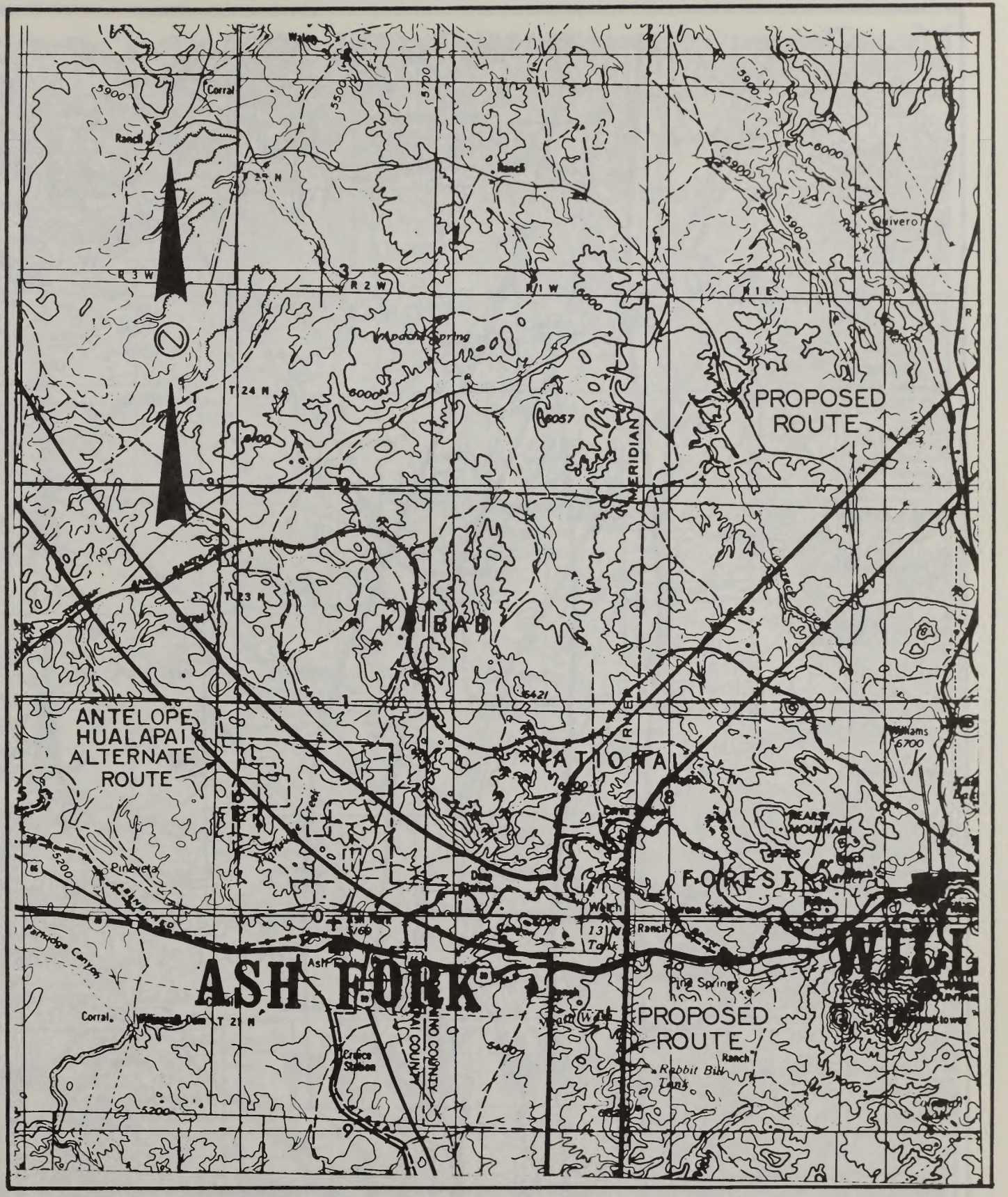


PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

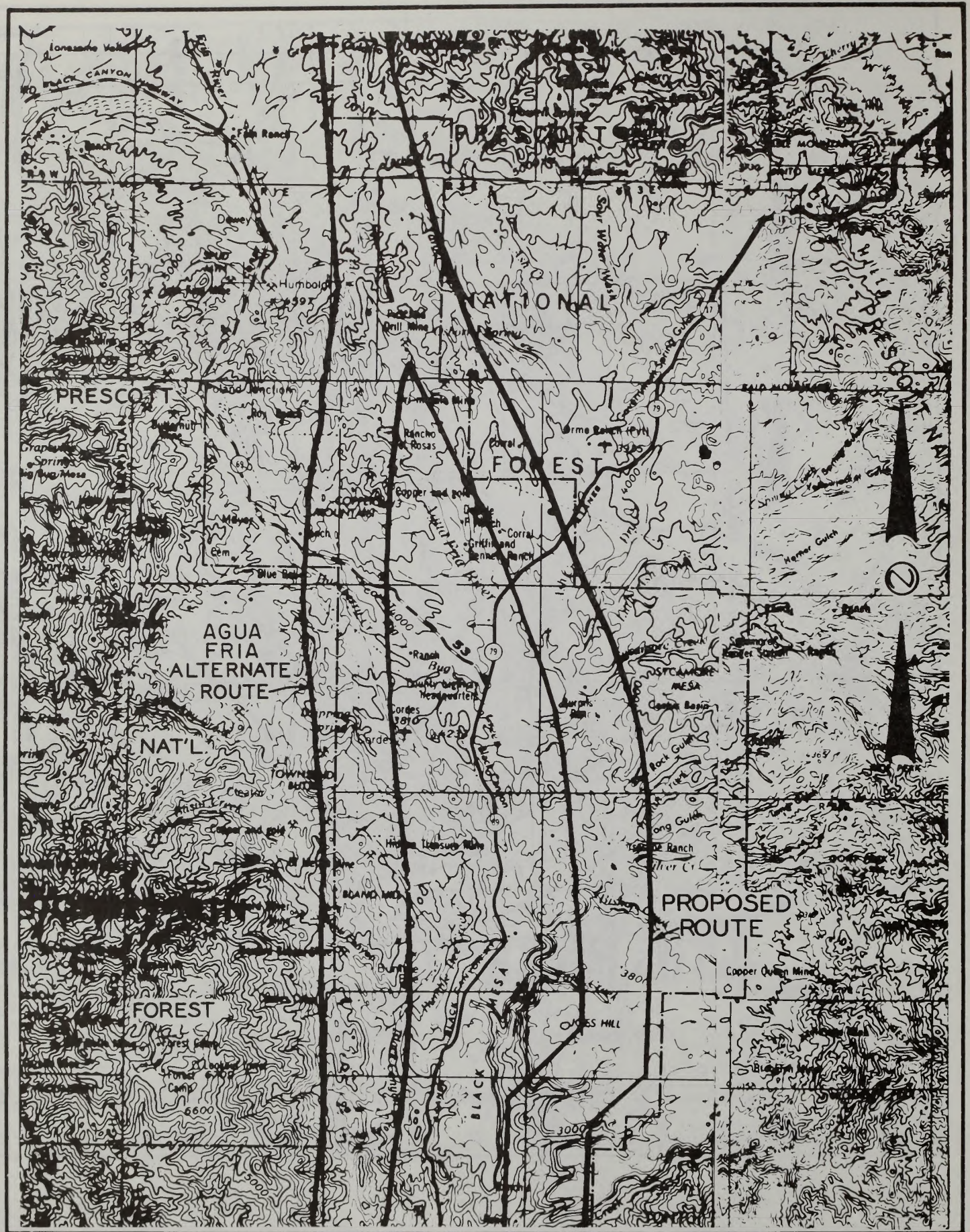


PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

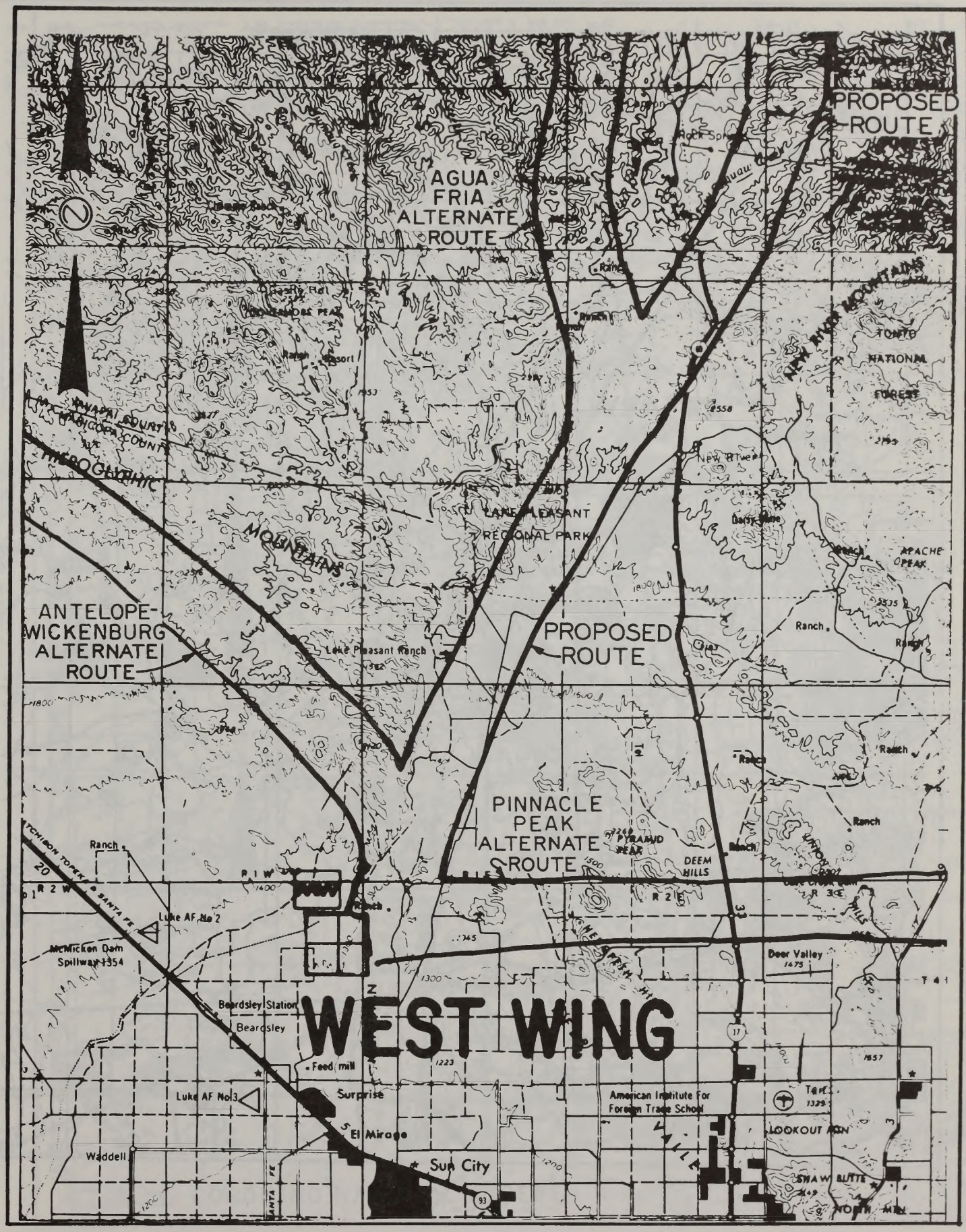
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PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES



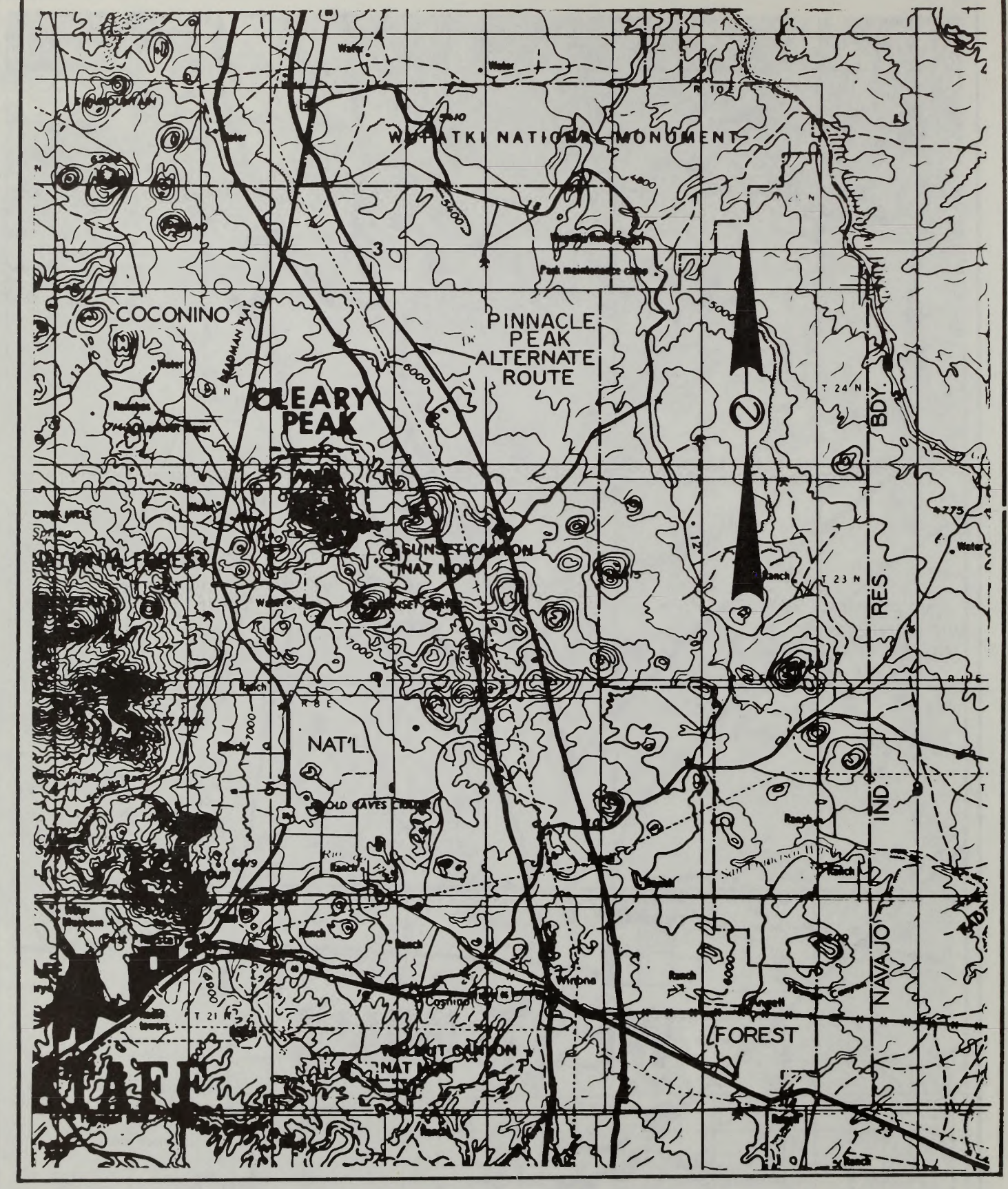
PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES



PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

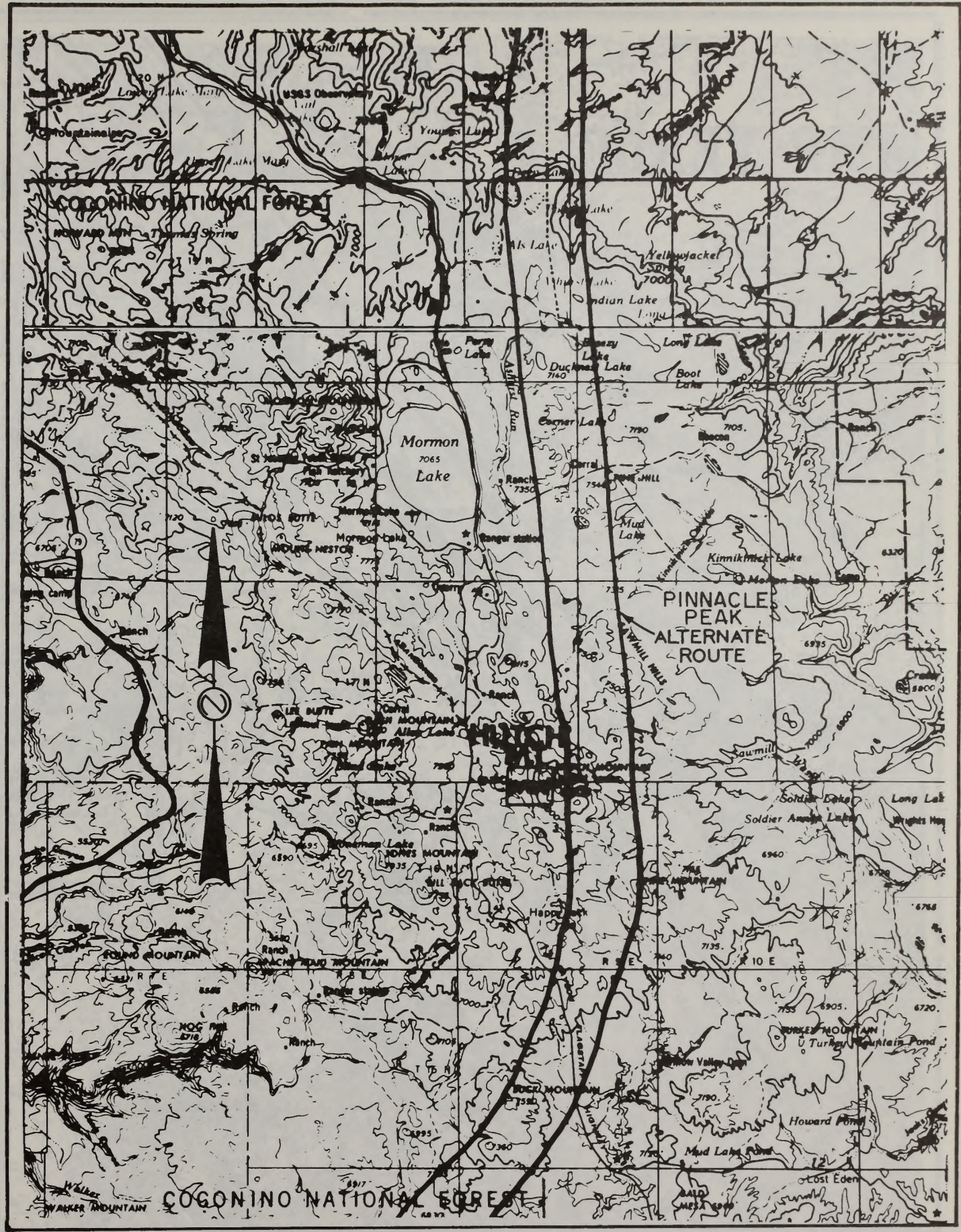
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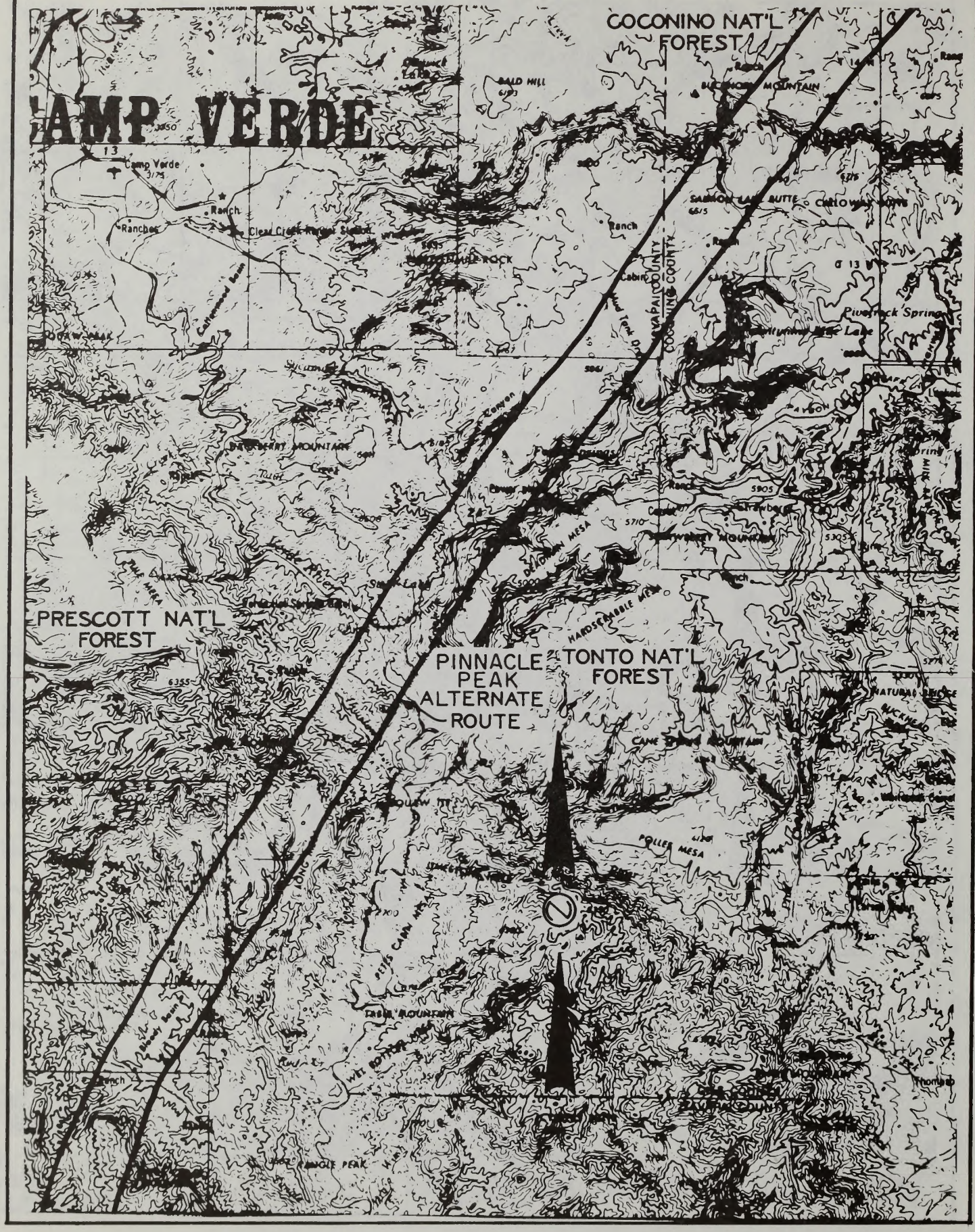


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ALTERNATE ROUTES

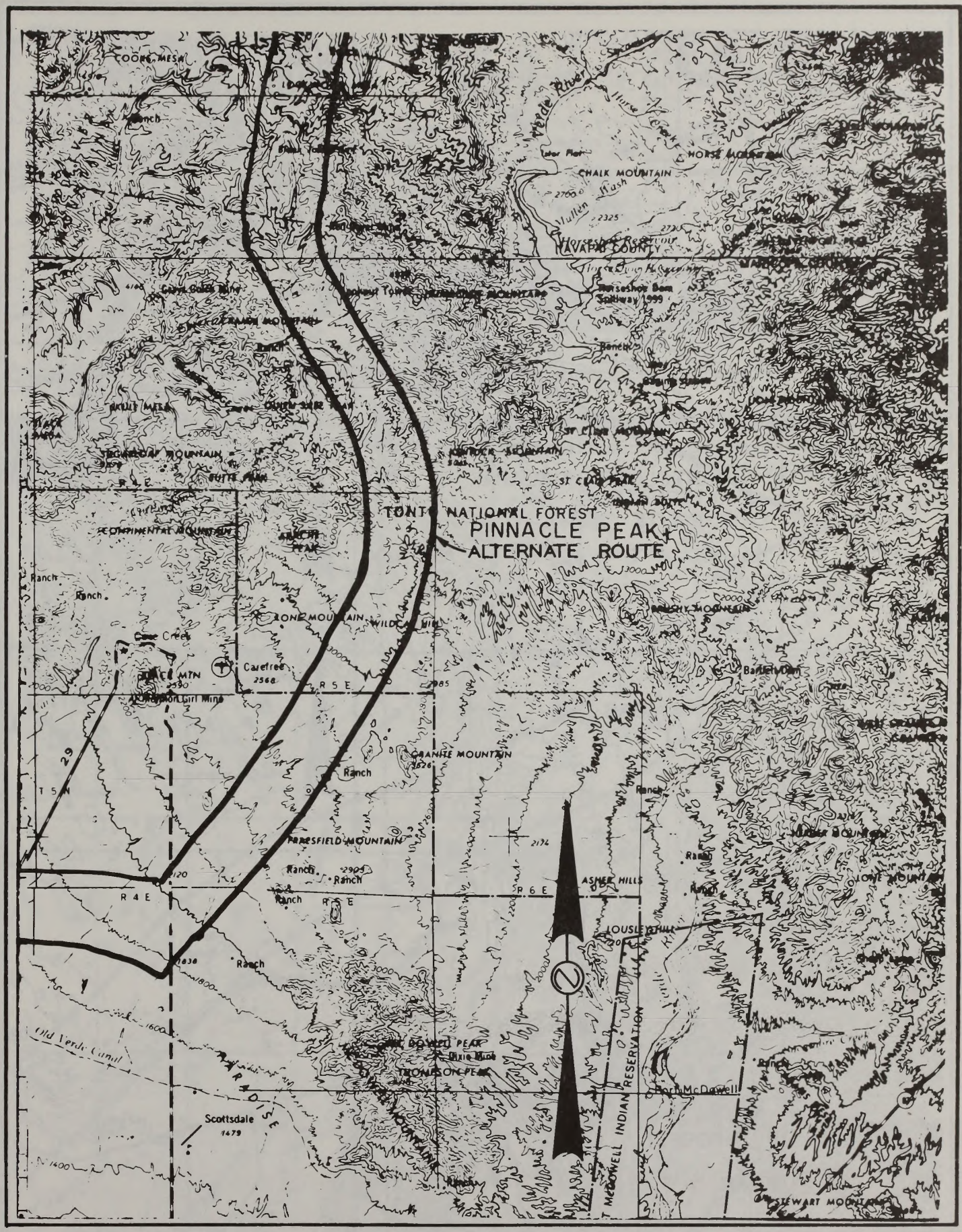
ILLUSTRATION 17H



PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES



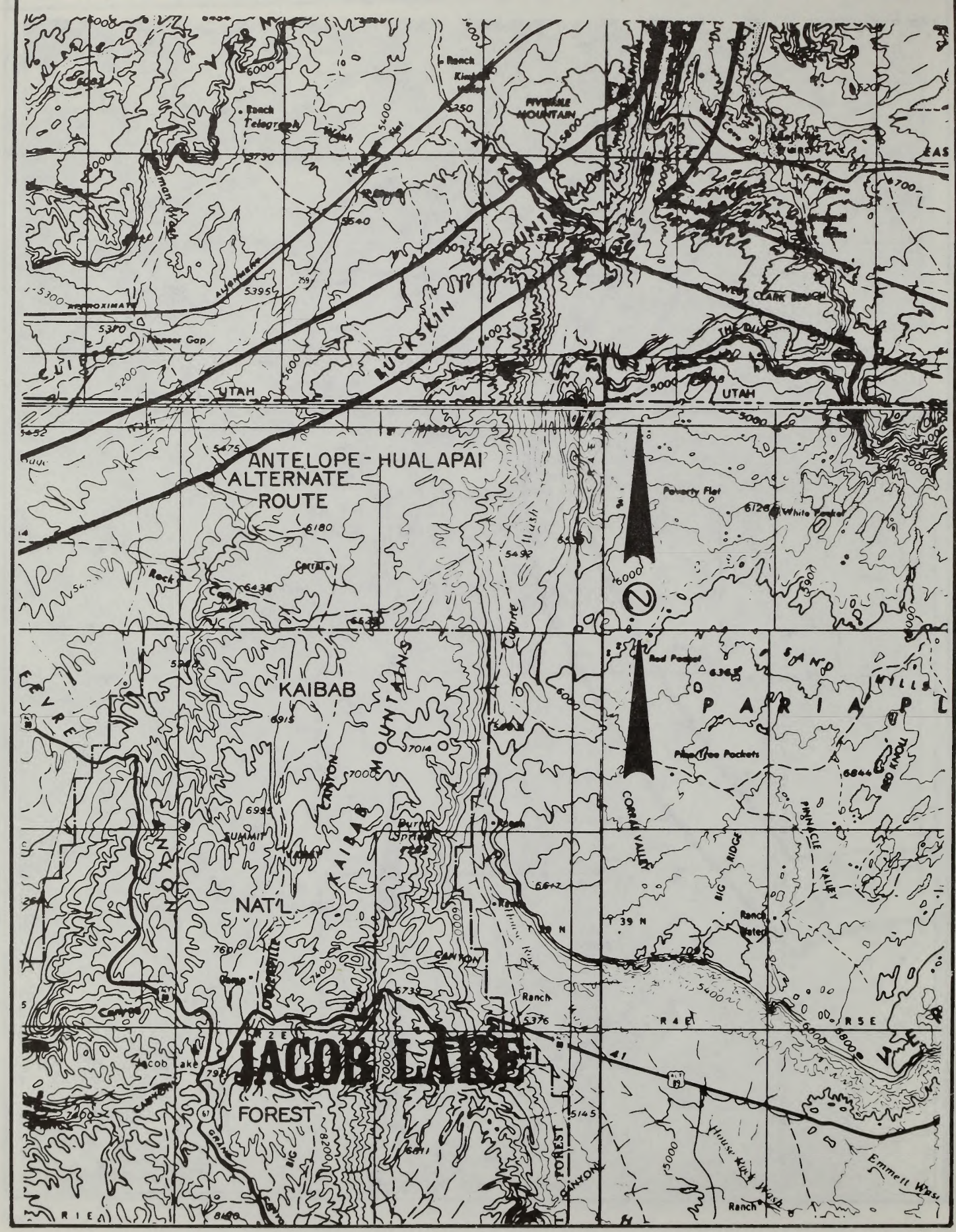
PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES



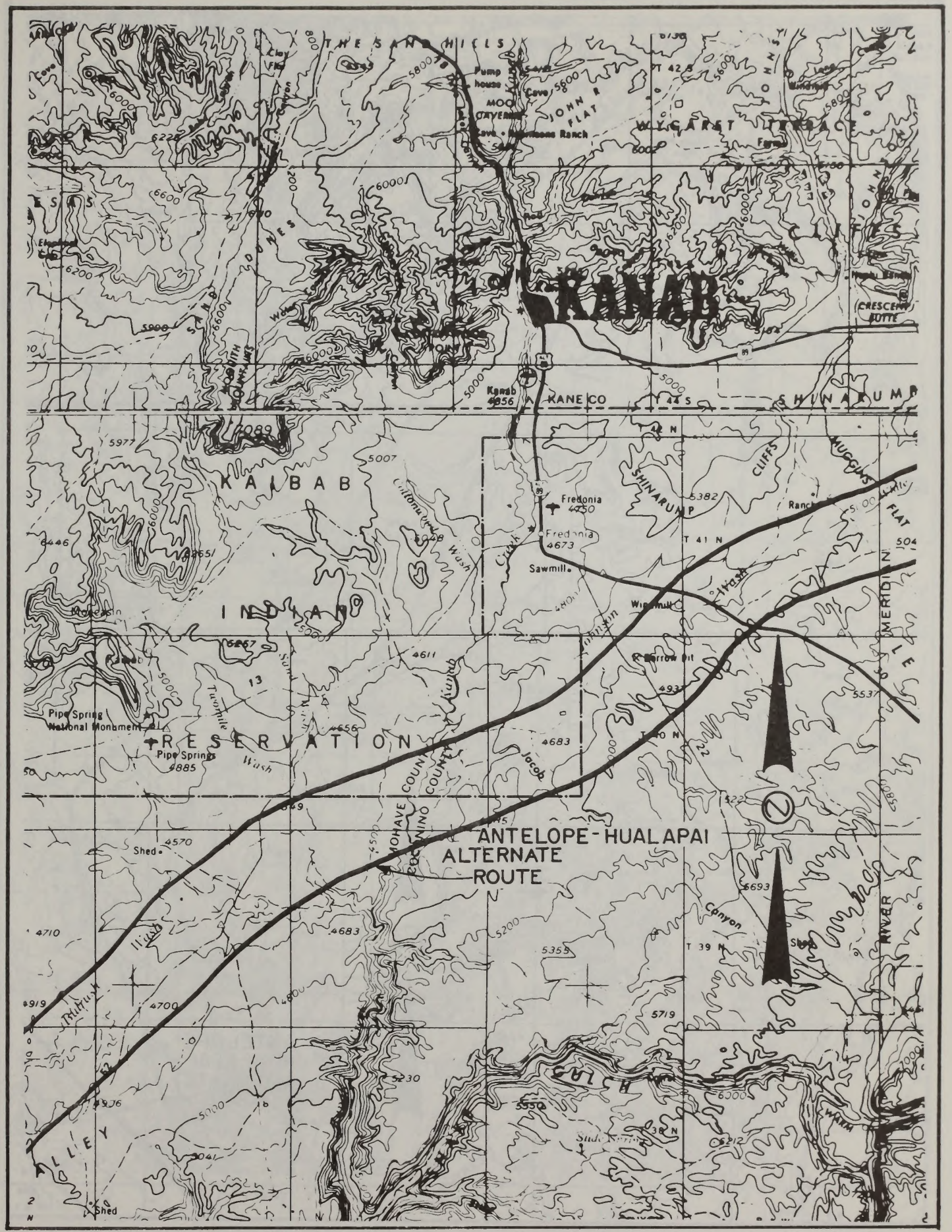
PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

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ILLUSTRATION 17 K

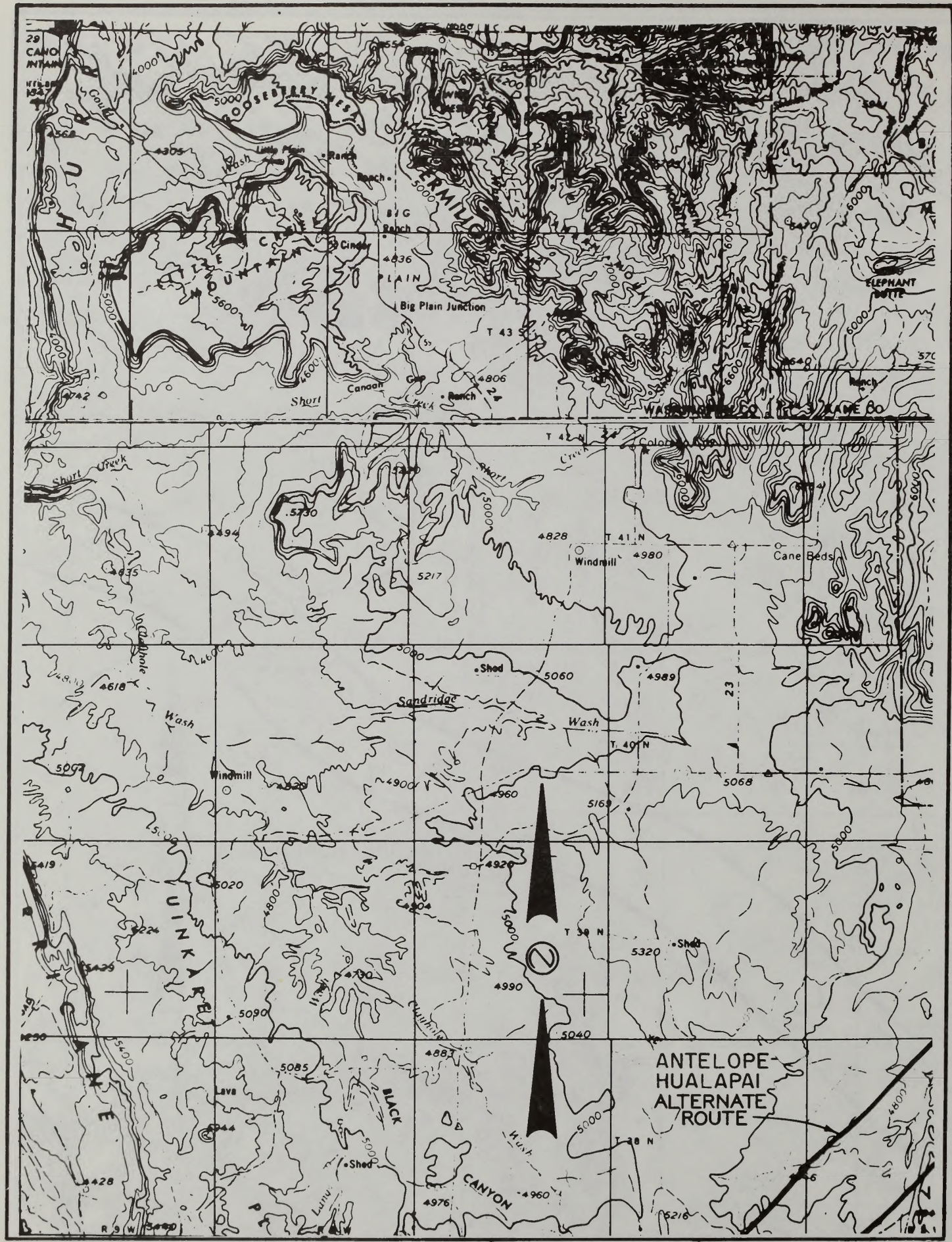


PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES



PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

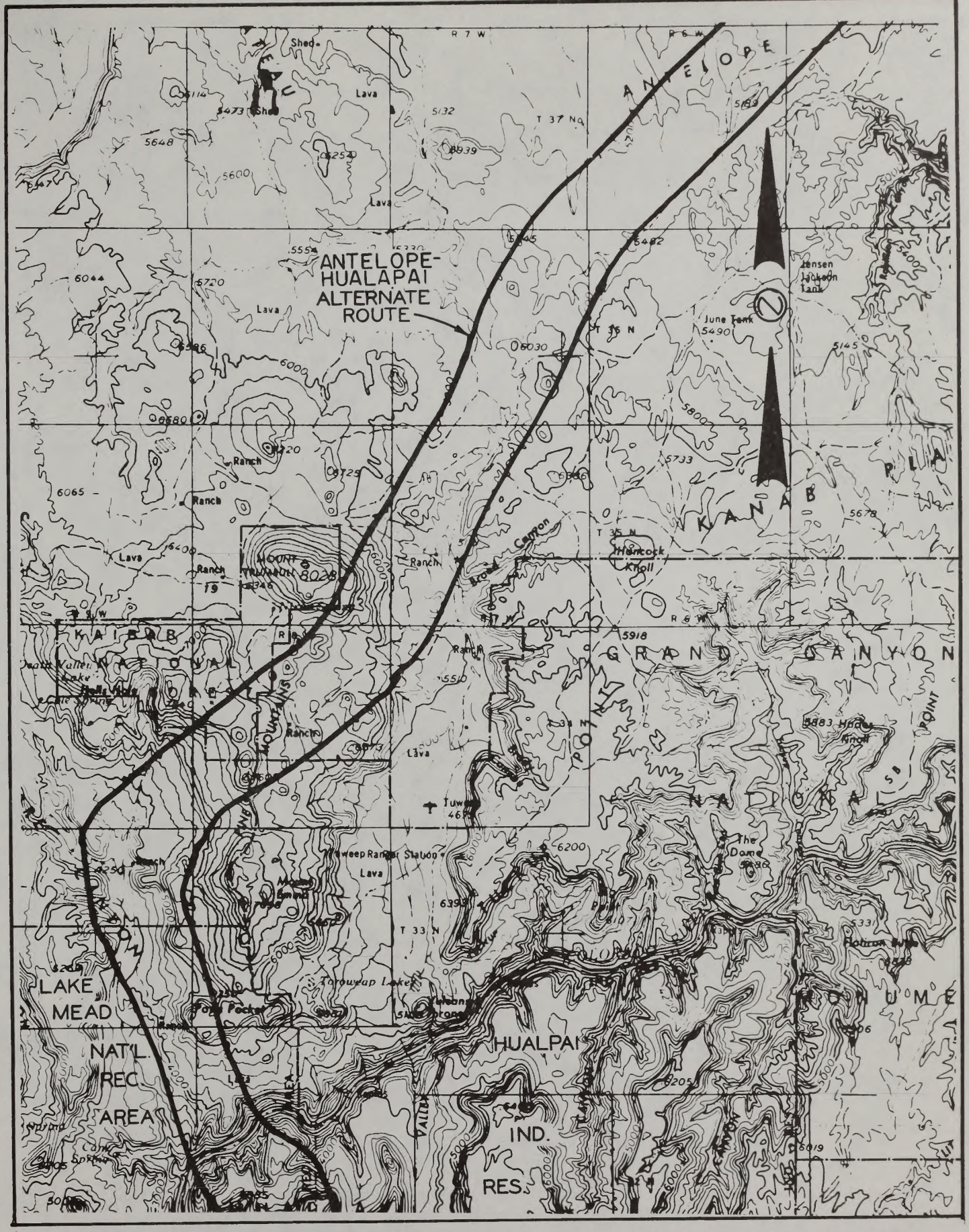
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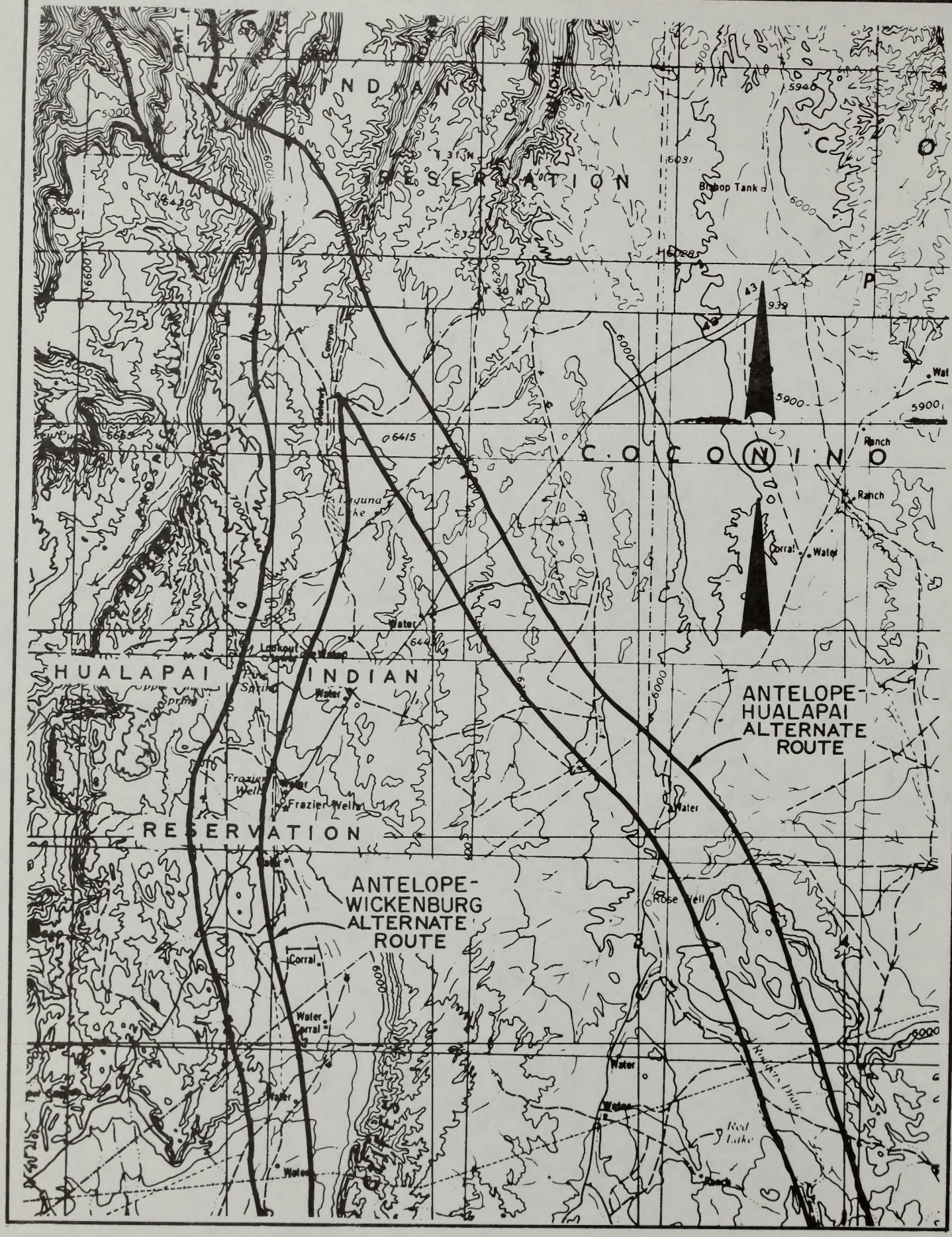
PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

4-18-75

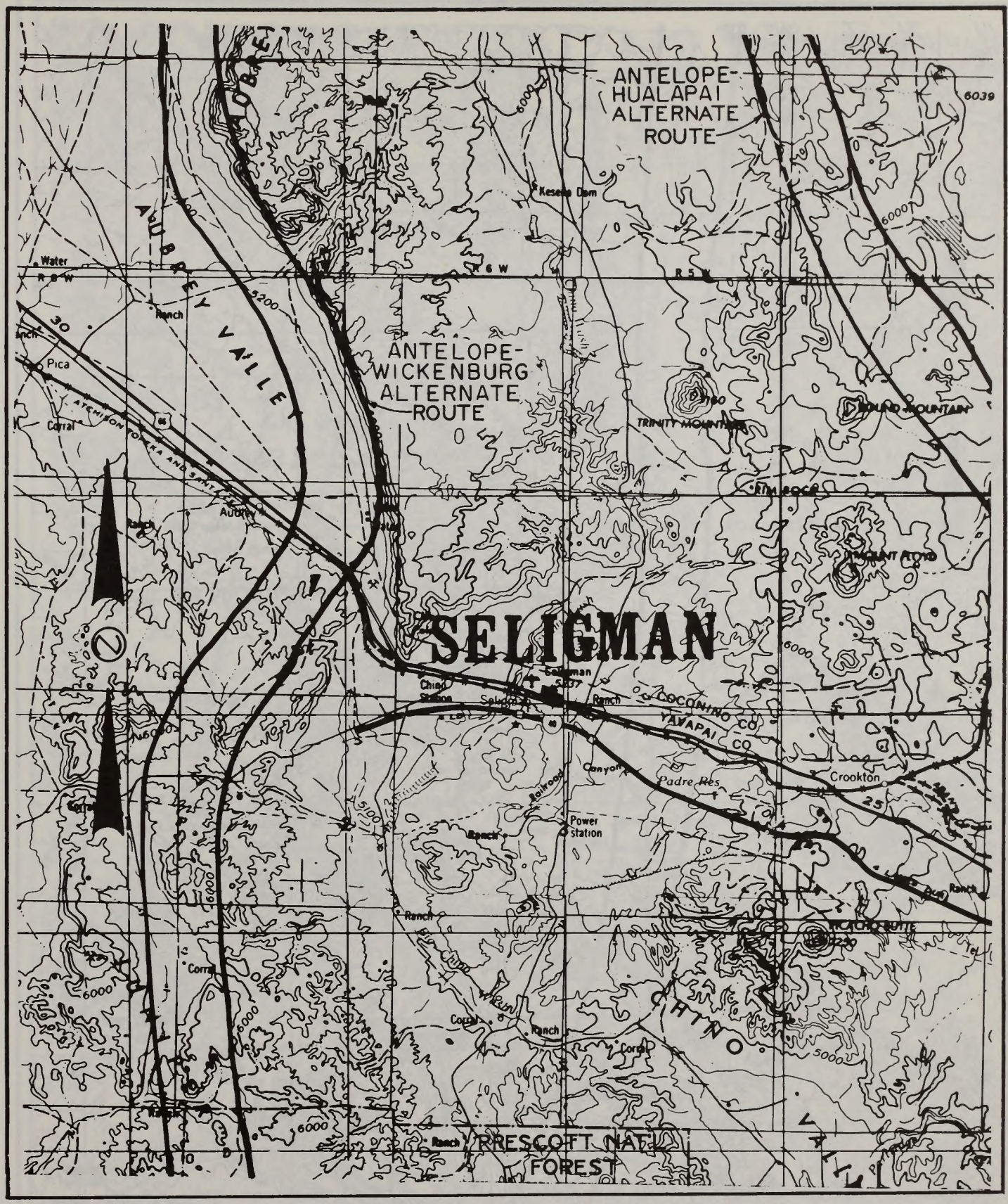
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PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

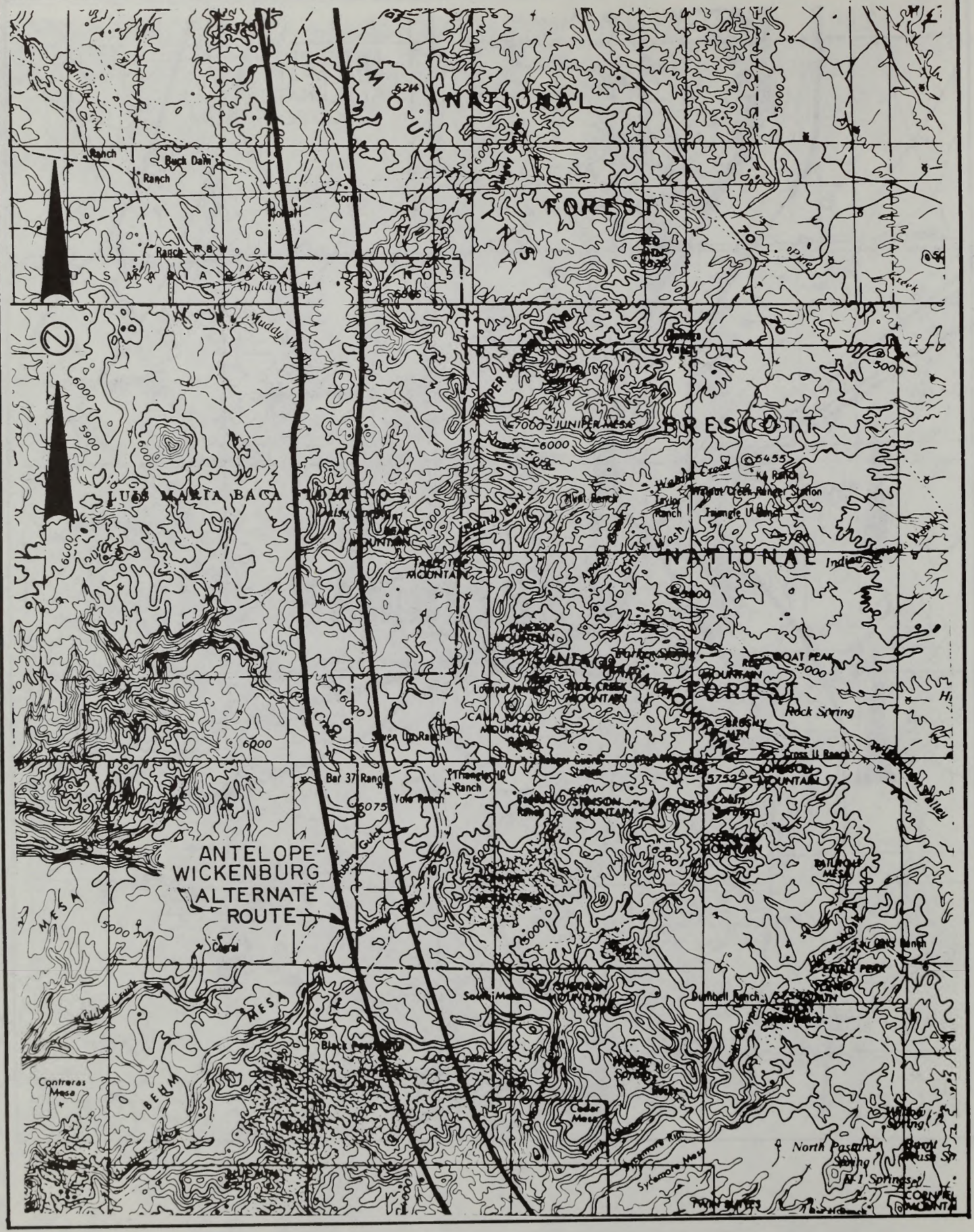


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ALTERNATE ROUTES



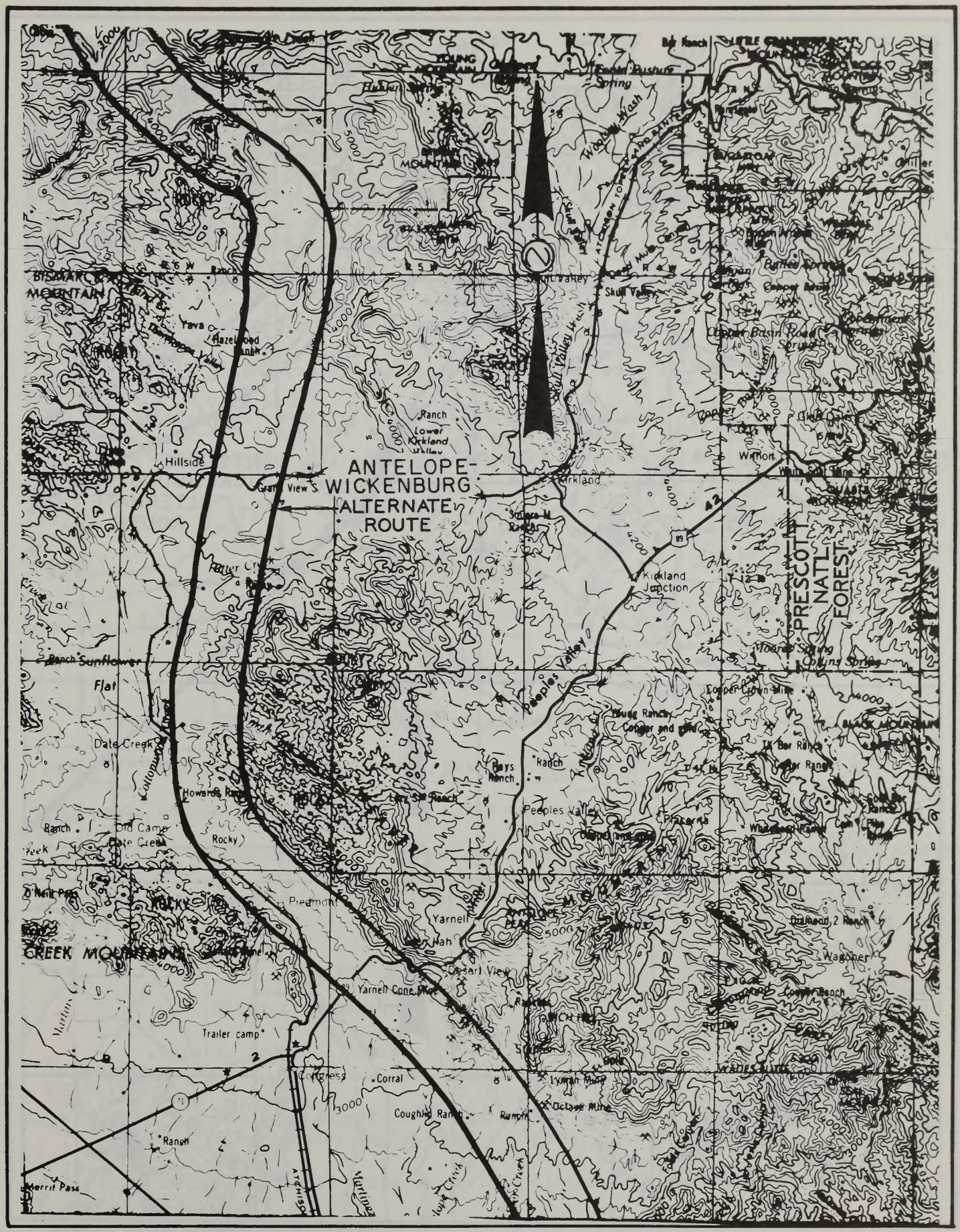
PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

ILLUSTRATION 17.0



PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

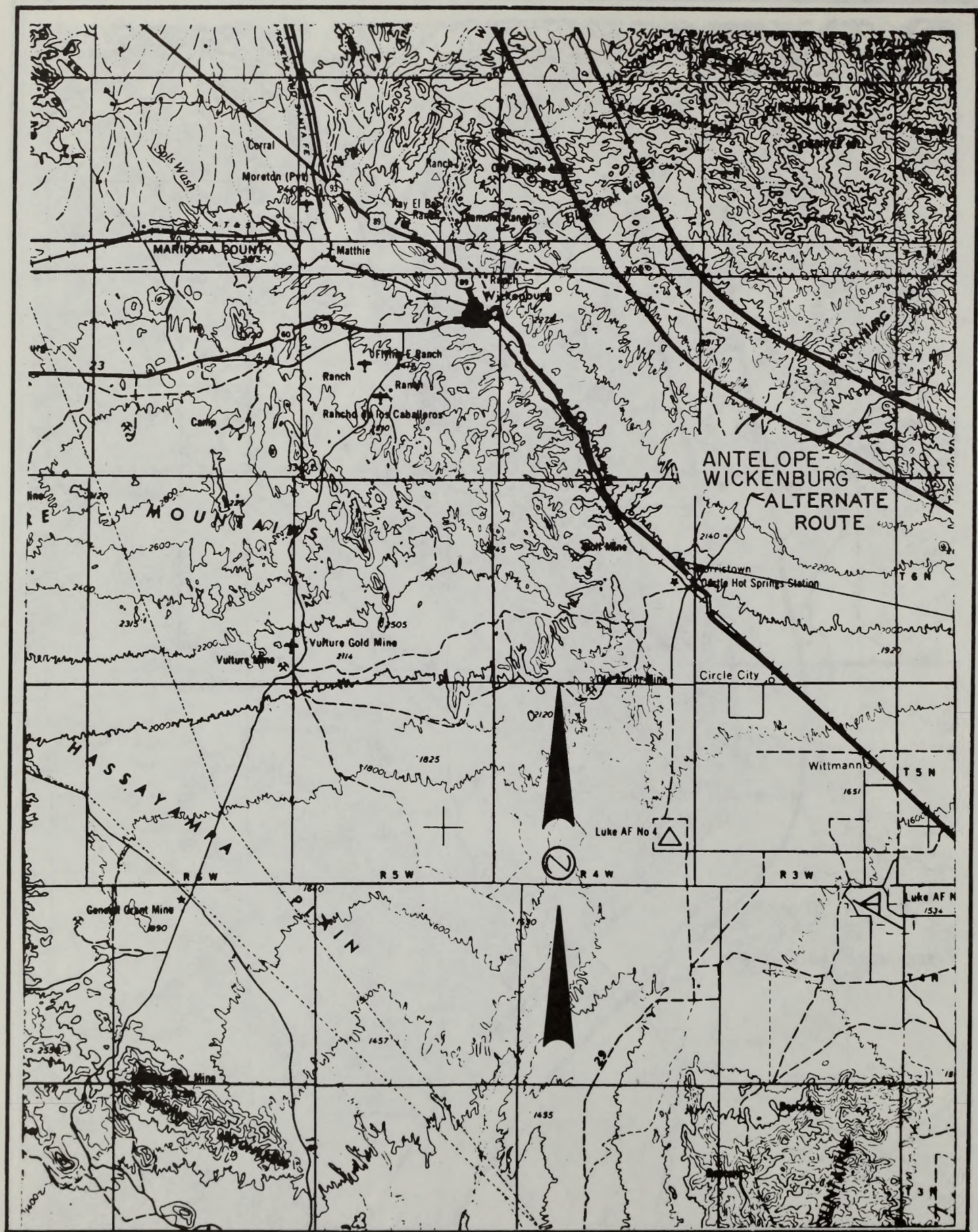
ILLUSTRATION 17 R



PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

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ILLUSTRATION 17 S



PROPOSED KAIPAROWITS - WESTWING
ALTERNATE ROUTES

4-18-75

ILLUSTRATION 17.T

and head southwest for about 3.6 miles. It continues south crosses the Nipple Bench area for 1.1 miles to the Nipple Creek area. Nipple Butte, a prominent sandstone formation, lies three-quarters of a mile west of the alternate route.

The route would then follow Nipple Creek south for about one mile where it would turn southwest for 2.3 miles toward the Wahweap Creek Basin. After crossing Wahweap Creek, the route would continue south for about two miles to merge with the proposed route just south of the U. S. Highway 89 crossing. This route would then follow the proposed route to the Westwing Substation (302 miles).

The John Henry alternate route would be three miles longer than the proposed route.

Description of the environment

The environmental conditions along this route are similar to that of the proposal.

Environmental impacts of alternate action

Environmental impacts for this route would be similar to that of the proposal, however, an additional 28 acres of surface disturbance would occur. A geologically unique erosional area of pinnacles and balanced rocks along the proposed route would be avoided by this alternative (see East Clark Bench to Flattop alternate).

Mitigating measures

Same as proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

An additional 28 acres of surface disturbance would be the only additional effect that cannot be avoided.

West alternate

Description of alternate action

The route would begin at the Kaiparowits Generating Station and follow the same route described for the Eldorado-Kaiparowits East Clark alternate for 12.2 miles. Instead of angling west like the East Clark alternate, this route would continue south for about 1.2 miles to join the proposed route to Westwing Substation. This route would be 301 miles long.

Description of the environment

The environment would be similar to that for the East Clark Bench to Flat Top alternate.

Environmental impacts of alternate action

This alternate is one mile shorter than the John Henry alternate, but it would disturb 19 acres more than the proposed route. Environmental impacts would be similar to the John Henry alternate.

Mitigating measures

Same as proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

Same as the proposed route except that 19 acres more would be disturbed.

Cedar Ridge alternate

Description of alternate action

The Cedar Ridge alternate is the same as the proposed Kaiparowits to Westwing route with one exception. This alternate would follow the proposed route for 68 miles, then leave the proposed route and proceed south-southwest over Cedar Ridge Hills. The alternate would then descend the Echo Cliffs at a gap immediately northeast of the U. S. 89 junction at Cedar Ridge Trading Post. The route would then proceed to the east of Bodaway Mesa, and continue south-southeast to the west of Shadow Mountain, and finally terminate at the Moenkopi Switching station. Total

length from Kaiparowits to Westwing, using this alternate, would be 301 miles. This is two miles longer than the proposed route.

Description of the environment

There are relatively few differences between existing environments along the proposed route and the Cedar Ridge alternate. Geology and topography are similar except for the diversion around "The Gap." Along this 56.2-mile segment the alternate would traverse the edge of the gently rolling Cedar Tree Hills, Cedar Ridge, and Bodaway Mesa (6,000-6,400 ft.).

The alternate route would have 12.4 more miles of "medium" rated archeological sensitivity, and seven fewer miles of "low" rated sensitivity than the proposed route. Ratings were determined by the Museum of Northern Arizona.

There are no existing visual intrusions where the alternate would descend Echo Cliffs, although there are twin 500 kv and twin 345 kv transmission lines at the "Gap" crossing of the proposed route.

Environmental impacts of alternate action

The Cedar Ridge alternate would create a significant visual intrusion and aesthetic impact where it crosses Echo Cliffs. It would be highly visible from U. S. Highway 89 in both directions for several miles. It would also intrude upon 68 miles of virtually undisturbed colorful desert landscape and disturb an additional 224 acres of soil and vegetation with required roads.

Impacts to the archaeological, paleontological, and historical values would possibly be greater than those on the proposed route according to the Museum of Northern Arizona.

Mitigating measures

Same as proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

Transmission towers and conductors would be highly visible from U. S. Highway 89 in spite of measures to mitigate visual and aesthetic impacts. Nineteen acres more would be occupied by this alternate.

Agua Fria alternate

Description of alternate action

The Agua Fria alternate would follow the same alignment as the proposed route for the first 236 miles. At a point east of Dewey, the alternate would turn south to cross State Highway 69 northeast of Cordes Junction, and continue south just east of Cleator and west of Bumble Bee along the east foothills of the Bradshaw Mountains. The route would cross the Agua Fria River at a point one mile north and three miles east of Lake Pleasant Regional Park. The alternate would join the proposed route at this point, 18.2 miles north of the Westwing Substation. Total length of the Agua Fria alternate would be 296 miles, three miles shorter than the proposed route.

Description of the environment

Recreational resources on this alternate route differ from the proposed route because the alternate would pass through the Black Canyon Trail Area designated by the Secretary of the Interior. This area is heavily used by recreationists, as a scenic, backpacking, and horseback riding area.

The Bureau of Land Management has also, through its planning system and public meetings, designated a transmission system right-of-way corridor in the Black Canyon area. This corridor follows the alignment of two existing APS 500 kv powerlines east of Interstate 17. The proposed route would follow this corridor.

The Forest Service has proposed the southeast part of the Prescott National Forest, west of Interstate 17, for inclusion in the National Wilderness Preservation System.

This alternate would pass through the habitat of an isolated antelope herd

and also a critical area for antelope fawning. These sensitive areas would be similar to those of the proposed route.

The alternate route would bypass the sensitive Perry Mesa Archaeological district discussed in Chapter II. Also of historical significance are numerous old mining camps and diggings in the area.

Environmental impacts of alternate action

This alternative would seriously intrude upon scenic quality and hiking and horseback riding activity in the Black Canyon Trail Area. It would also degrade primitive values of the proposed wilderness area in the Prescott National Forest. The alternative would detract from historical values of old mining camps in the area, and reduce critical habitat for the isolated antelope herd.

The Perry Mesa Archaeological District, under nomination for the National Register, would be avoided by this alternate.

Mitigating measures

Same as proposed route.

Any adverse effects that cannot be avoided should the alternate be implemented

Intrusions on scenic quality by commitment of the land to a utility corridor could not be avoided. Also, reduction of wildlife habitat and increased human disturbance would be unavoidable.

Pinnacle Peak alternate

Description of alternate action

This alternate would follow the Kaiparowits to Westwing proposed route to the Moenkopi Switchyard, it would then turn south and follow the Bureau of Reclamation 345 kv transmission line to Gray Mountain and continues south along the west side of U. S. Highway 89 to an area west of the Wupatki National Monument. From there the

line would turn south-southeast across U. S. Highway 89, and continue approximately one mile east of Cleary Peak and Sunset Crater National Monument. It would continue to Winona and cross Interstate 40. It would then head south to east of Mormon Lake, Hutch Mountain and Happy Jack, then southwest passing over Buck Mountain to the east of Buckhorn Mountain; past Childs Power Plant at the Verde River and through Bloody Basin to near West Cedar Mountain. The alternate would continue following the Bureau of Reclamation 345 kv right-of-way west past Humbolt Mountain Lookout. The alternate would then turn east, past the Ramm Mountain, then back southwest to the west of Kentuck Mountain, and west of Granite Mountain, and into Pinnacle Peak Substation.

From the north side of Pinnacle Peak Substation, the alternate would go due west to Westwing Substation. Total length would be 301 miles, two miles longer than the proposal.

Description of the environment

The Pinnacle Peak alternate is similar to the proposal with the exception of 32 miles of productive ponderosa pine timber country in the Coconino National Forest east of Mormon Lake near Flagstaff, Arizona. This area receives heavy recreational use because of the numerous small lakes and forest environment. Visual quality of this route is higher than that of the proposed. The route would pass through habitat of the endangered peregrine falcon and critical winter range for waterfowl, golden eagle, and the endangered bald eagle.

Environmental impacts of alternate action

Major differences in impacts would be to vegetation, wildlife and recreation resources. Critical wildlife habitat for two endangered species (peregrine falcon and bald eagle) would be reduced.

The impact to timber in this area would be a reduction of the annual allowable cut of 140,000 board feet and 130 cords of pulpwood. Over the life of the project (50 years), 7 million board feet and 6,500 cords of pulpwood would be lost. There

would be a lesser impact to the soils and ground cover, along this alternate, but ground disturbance through the forest would create major visual intrusions and effect the quality of recreationists outdoor recreation experience.

Mitigating measures

The mitigating measures would be the same as for the proposed route with the exception of vegetation. The impact of reduced cutting of ponderosa pine could be mitigated by using the cleared right-of-way for Christmas tree production or other land use that would produce a product to replace the loss of timber.

Any adverse effects which cannot be avoided should the alternate be implemented

The commitment of the land, loss of scenic quality, and loss of timber production are impacts that cannot be mitigated during the life of the project. Reduction of wildlife habitat, increased access and human disturbances would also be unavoidable.

Antelope - Hualapai alternate

Description of alternate action

The Antelope-Hualapai alternate would begin where the proposed Kaiparowits-Eldorado route starts to parallel the existing LADWP Navajo-McCullough 500 kv transmission line. The alternate would parallel that route for approximately 40 miles. The route would turn southwest for 25.5 miles, cross Antelope Valley (elevation 5,000 feet) and turn slightly more to the south entering Toroweap Valley. The route would cross this valley for approximately 10 miles, skirting the slopes of Mt. Trumbull, which lies to the west, and continues south of Mt. Trumbull for three miles. The route would then angle southwest for about eight miles through rough terrain to a point about three miles north of the Grand Canyon National Park boundary in Whitmore Canyon. At this point, the route would turn south toward Grand Canyon and pass through Whitmore Canyon to a river crossing within the park area, a distance of about 10

miles. The crossing (elevation 4,500 feet) would be about two miles upriver from Whitmore Rapids, a pick-up point for rafting parties.

After crossing the Grand Canyon and entering the Hualapai Indian Reservation, the route would turn southeast for 2.4 miles to a plateau (elevation 6,200 feet). The route would continue southeast about four miles across the plateau and descend into the one-mile wide Prospect Valley (elevation 5,700 feet). It would run south down the valley for two miles, turn back to the southeast and ascend Aubrey Cliffs to a plateau at 6,000-foot elevation.

Antelope-Hualapai alternate would then extend through Hualapai Indian Reservation, run east of Rose Well and Round Mountain, and intersect the APS 500 kv southern transmission corridor six miles east of Ash Fork and north of I-40. The alternate route would be the same as the proposed route from this point south to Westwing. Total length of the Antelope-Hualapai alternate would be 335 miles, or 36 miles longer than the proposed route.

Description of the environment

Air quality differs slightly along the Antelope-Hualapai alternate route because the coal-burning generating plant at Page and the relatively dusty stretch of U. S. Highway 89 through the Navajo Reservation would be by-passed.

The Antelope-Hualapai alternate would leave the Kaiparowits to Eldorado line and would traverse about 145 miles of virtually undisturbed terrain. Environment along this segment is essentially the same as that of the proposed route north of U. S. Interstate 40.

Another major difference between the existing environment along this alternate route and the proposed route is the proposed crossing of the Grand Canyon two miles upriver from Whitmore Rapids. The Glen Canyon crossing of the proposed route would be within Glen Canyon National Recreation Area, while the Hualapai-Antelope crossing would fall within the Grand Canyon National Park. The alternate would pass through important elk habitat and golden eagle nesting areas.

The Antelope-Hualapai alternate would also by-pass the Navajo Indian Reservation and Moenkopi Switching Station.

Environmental impacts of alternate action

Since this alternate would cross 145 miles of undisturbed land and would be 36 miles longer than the proposed route, it would result in the disturbance of 338 more acres.

Aesthetic impacts would also be greater because the alternate would cross Grand Canyon. Although this part of the canyon isn't easily accessible, transmission lines would be visible to recreational users such as raft parties on the river. There would be a reduction in wildlife habitat, an increase in access and human disturbance along this route.

Mitigating measures

Same as proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

There would be more ground disturbances and related impacts as a result of 36 additional miles of this alternate.

There would also be greater aesthetic impacts where the line would cross Grand Canyon, and on the 145 miles of virtually undisturbed lands.

Antelope-Wickenburg alternate

Description of alternate action

The Antelope-Wickenburg alternate would begin at the Kaiparowits plant site and end at the Westwing Substation. It would be 335 miles in length or about 36 miles longer than the proposed route. This alternate would follow the same route as the Antelope-Hualapai alternate to the crossing of the Aubrey Cliffs on the Hualapai Indian Reservation. At this point, the Antelope-Wickenburg alternate would break away in a southerly direction and run generally along the eastern edge of Aubrey

Valley and down Chino Wash at the foot of the cliffs. About 45 miles from the starting point, the route would swing slightly to the west and cross U. S. Highway 66 and I-40 west of Seligram, Arizona.

The Antelope-Wickenburg alternate would then continue south into the northwestern corner of the Prescott National Forest, traverse Juniper Mountains, and begin a slight curve to the south-southeast. It would descend the south face of Behm Mesa, and cross east of Bismark Mountain. The route would turn to the south-southwest and continue until it turns between the Weaver and Date Creek mountains. The route would cross U. S. Highway 89/Arizona Highway 71 about four miles southwest of Yarnell.

The route would continue southeast for about 40 miles, pass generally between U. S. Highway 60-89/Arizona Highway 93 and the Wickenburg and Hieroglyphic Mountain Ranges. It would cross the Agua Fria River, and terminate at the Westwing Substation.

Description of the environment

Major differences between the proposed Kaiparowits to Phoenix route and the Antelope-Wickenburg alternate would be the additional 36 mile length, 264 miles of new transmission line corridor, five additional miles of highly fragile Sonoran desert scrub, and 16 miles of ponderosa pine forest which would be crossed. There are also about 26 abandoned mining operations concentrated in the Wickenburg area. The line would cross through a mountain lion refuge and areas of mule deer habitat.

There are no significant differences in other types of resources crossed by the Antelope-Wickenburg alternate compared to the proposed route.

The Antelope-Wickenburg alternate has not been surveyed for archaeological, cultural, or historical resources to the same degree as the general area of the proposed route; therefore, good information is lacking.

Environmental impacts of alternate action

The greatest difference in impacts of the Antelope-Wickenburg alternate and the proposed route would be the 264 miles of transmission line which would be built

over undisturbed lands. This would result in proportionately more disturbance and would open a new corridor which may be used for future transmission lines, pipelines, or other projects.

Impacts on archaeological and historical resources along the alternate route would be potentially greater since new roads would be opened into previously inaccessible country. Land use along the route would also change from open space to utility corridor. This could influence future land uses and development along the alternate.

Construction activities would cause surface disturbance to an estimated 338 more acres than the proposed route, based on an average of 9.4 acres per mile of tranmission line. Approximately 35 more acres of Sonoran desert scrub would be disturbed along this alternate.

Using the same base figure, about 112 acres of Ponderosa pine-Douglas fir forest would also be disturbed along the Antelope-Wickenburg alternate. None of forest type would be crossed by the proposed Kaiparowits to Westwing routing. Secondary impacts from human use would be very likely since this forest is relatively desirable as recreation land.

The Palo Verde-Saguaro or Sonoran desert scrub community has very low soil moisture, resulting in low vegetative productivity and revegetation potential after disturbance. Visual impacts of this route would be greater because of the degree of exposure of the line between the Highway 89 crossing near Yarnell and the Westwing Substation.

Impacts to wildlife would be greater than the proposed route because more habitat would be disturbed.

Other types of impacts would be similar to those discussed for the proposed route.

Mitigating measures

Same as the proposed route.

Any adverse impacts which cannot be avoided should the alternate be implemented

Alternate route construction activities would generally result in the same types of unavoidable impacts as would occur on the proposed route. Specifically, the Antelope-Wickenburg alternate would be highly visible from U. S. Highway 66 and would detract from the scenic value of the Aubrey Cliffs. It would also create visual impacts along U. S. Highway 89 between Wickenburg and Yarnell and north of U. S. 93 and U. S. 60, where it would intrude on views of the Wickenburg and Hieroglyphic Mountains and also where the line crosses Grand Canyon.

There would be some unavoidable damage to about 259 acres of fragile Palo Verde - Sonoran desert scrub community between Wickenburg and the Westwing Substation (35 acres more than the proposal), and about 112 acres of Ponderosa pine forest in and around Prescott National Forest.

Impact evaluation

An impact evaluation of all alternate transmission system routes for the Kaiparowits to Phoenix segment is contained in Figure 5.

Kaiparowits to Moenkopi to Mohave (Illustrations 18 to 18x)

John Henry, West, and Cedar Ridge alternates

These three alternates, which are discussed in the previous section, are also alternates to the Kaiparowits to Moenkopi to Mohave proposed route.

Detrital Valley alternate

Description of alternate action

This alternate would follow the proposed route from the plant site for 212 miles to an angle point at the Hualapai Indian Reservation boundary. At this point, the alternate would continue west following an existing 500 kv APS line. The alternate would proceed west through Hualapai Indian Reservation for two miles, and then angle southwest for 9.2 miles through a large valley area.

FIGURE 5

Impact Evaluation of Alternate Routes for Proposed Kaiparowits to Phoenix Route[a]

		Importance to decision making[b]	John Henry	West	Cedar Ridge	Agua Fria	Pinnacle Peak	Antelope-Hualapai	Antelope-Wickenburg
Mileage (more or less than proposed route)		5	+3	+2	+2	-3	+2	+36	+36
Climate		0			NN	NN	NN	NN	NN
Air Quality		1			SS	SS	SS	SS	SS
Geology and Topography	General	1			SS	SS	SS	SS	SS
	Seismology	1			NN	NN	NN	NN	NN
	Economic geology	1			NN	NN	NN	NN	NN
Soils	Erosion hazard	5			MM	MM	MM	MM	MM
	Rehabilitation potential[c]	5			MM	MM	MH	MM	MS
Water Resources	Quality	1			SS	SS	SS	SS	SS
	Demand	1			SS	SS	SS	SS	SS
Vegetation	Grazing (potential loss of forage)	4			SM	MM	MH	MM	MM
	Acres disturbed (permanent)	5			SS	SS	SH	SS	SS
	Acres disturbed (temporary)	6			SM	SS	SH	SM	SM
Wildlife	Terrestrial	8			SS	SM	MH	MH	MH
	Aquatic	4			SS	SM	SM	SS	SS
Ecological Interrelationships	Terrestrial	8			SS	SM	MH	MH	MH
	Aquatic	4			NN	SM	SM	SS	SS
Paleontology		5			SS	SS	SS	SS	SS
Archaeology		8			MM	MM	MM	SM	SM
History		5			SS	SM	SM	SM	SM
Recreation	General	8			MM	MH	MH	MH	MM
	Scenic values	10			MH	MH	MH	MH	MM
	Natural values	8			MH	MH	MH	MH	MH
Land Uses	Miles of new corridor (more or less than prop.)	10			+56	+45	+24	+145	+285
	Wood Products	3			SS	SS	MH	SM	SS
	Agriculture	1			NN	NN	NN	NN	NN
Socio-Economic	Housing and services	1			MM	MM	MM	MM	MM
	Culture and attitudes	5			MH	MM	MH	MH	MH

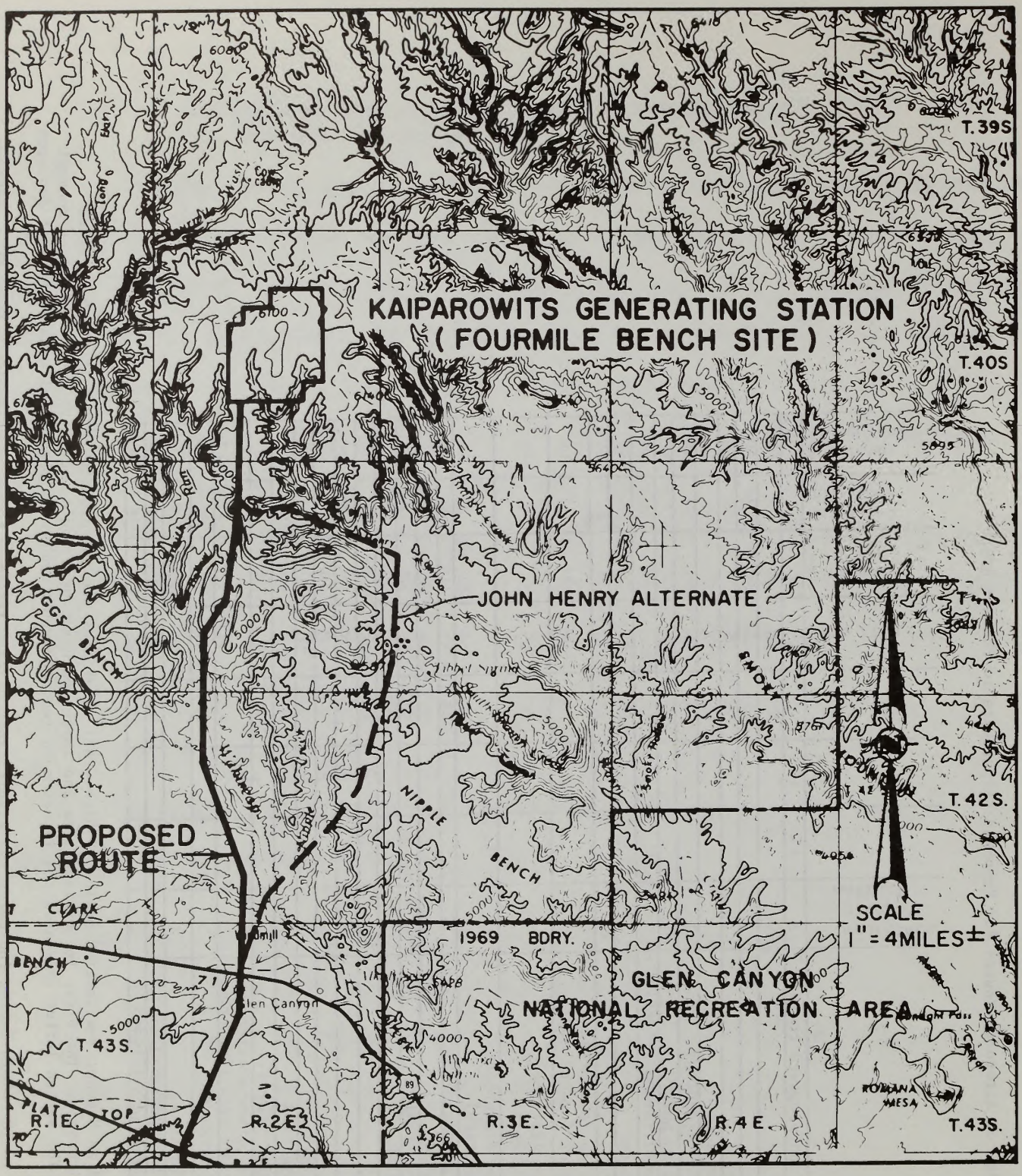
Same As Proposed Route

Same As Proposed Route

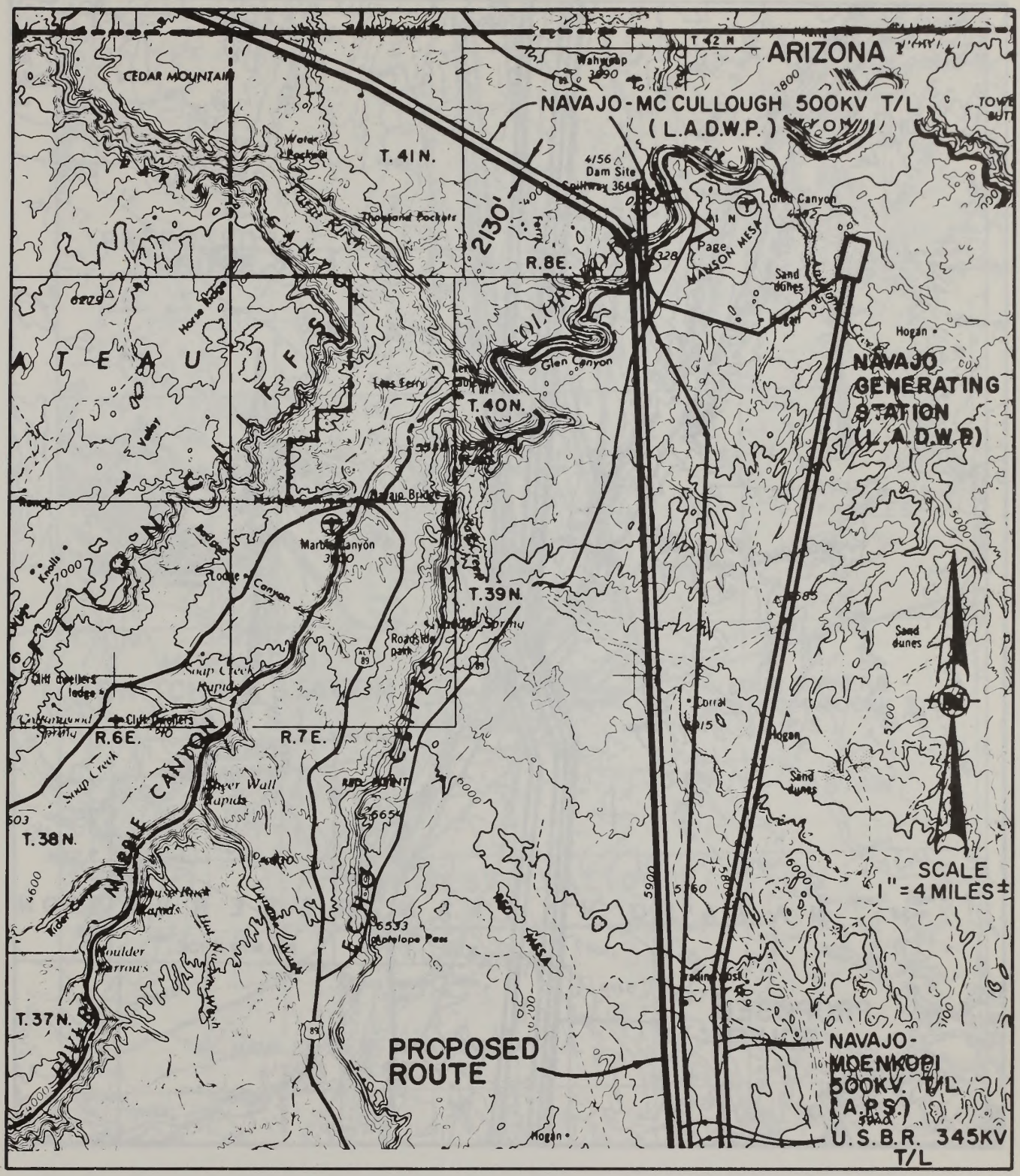
[a]Impacts rated as N-none; S-slight; M-medium; H-high - All alternates are compared to that part of the proposed route replaced by the alternate. The first letter indicates the impact each resource would undergo along the replaced segment of the proposed route. The second letter indicates the impact each resource would undergo along the alternate where it deviates from the proposed route.

[b]Rated from 1 to 10 - This rating indicates the significance of each resource to decision making. Generally, ratings are based either on the degree to which a resource or activity would be impacted, or on the degree of potential controversy surrounding the resource or activity; the higher the rating, the higher the potential for impacts or controversy.

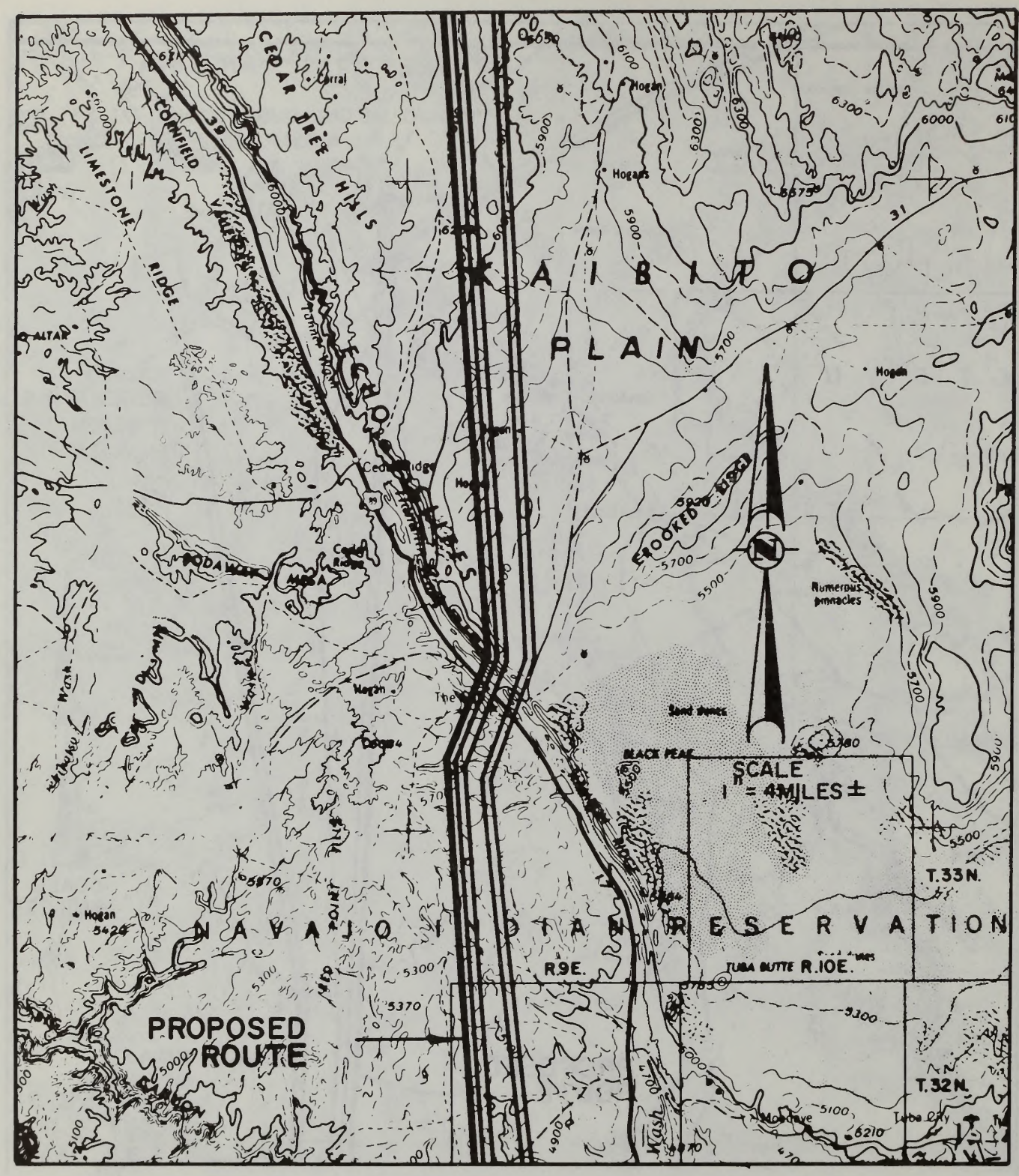
[c]This rating is not a comparison of impacts, but instead is a comparison of rehabilitation potentials.



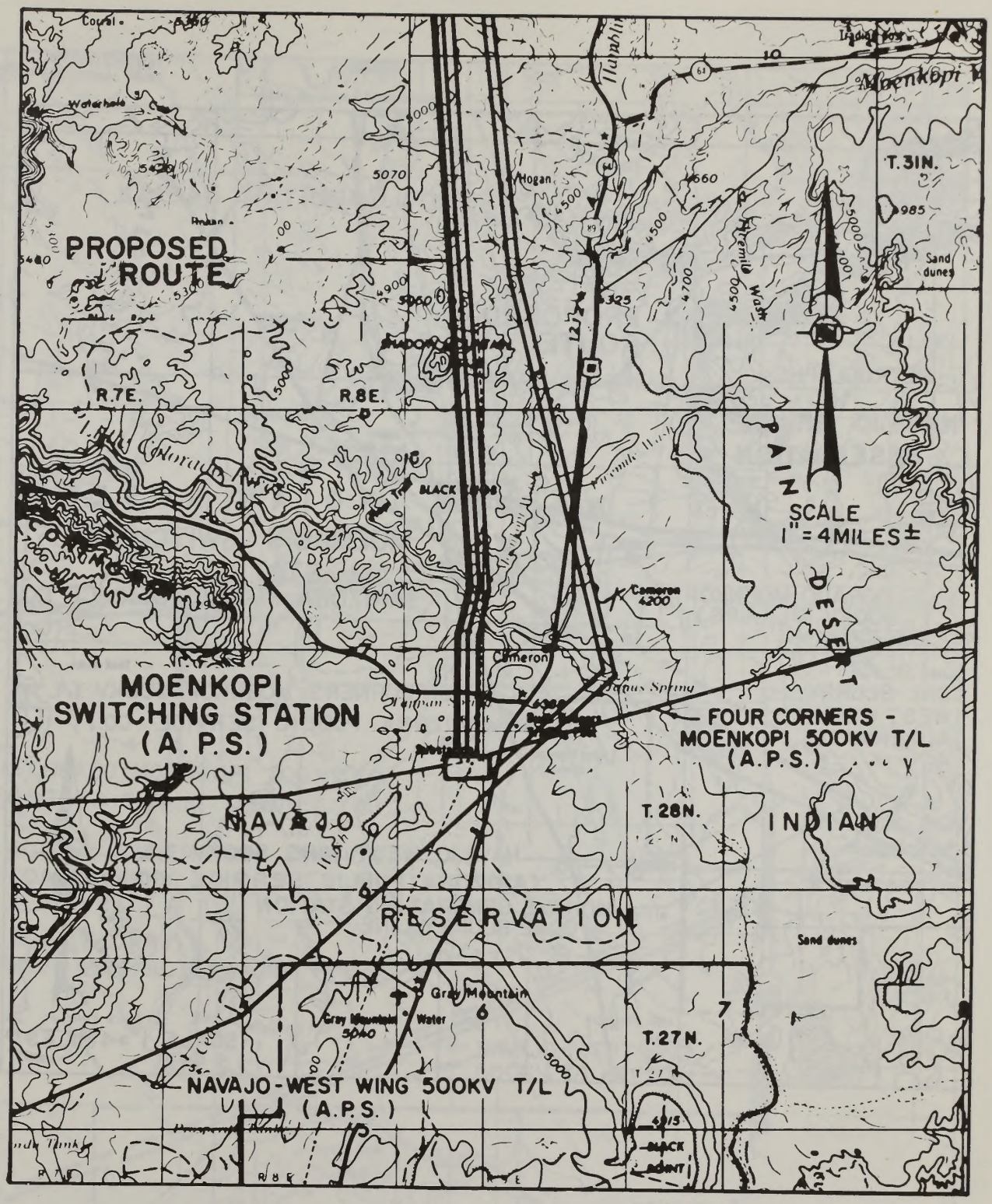
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AND ALTERNATE ROUTES



KAIPAROWITS - MOENKOPI - MOHAVE 500KV T/L
AND ALTERNATE ROUTES



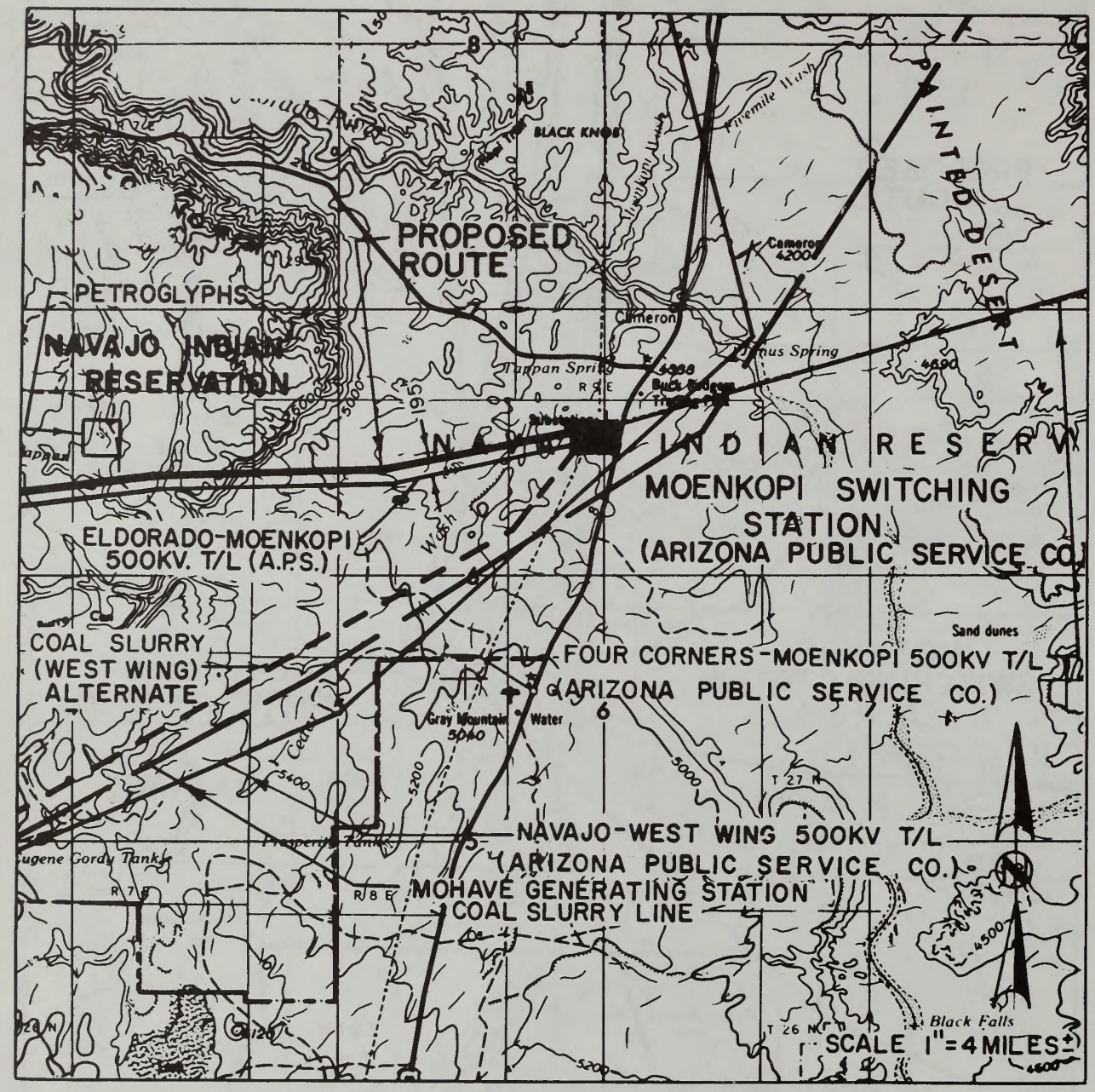
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AND ALTERNATE ROUTES



KAIPAROWITS - MOENKOPI - MOHAVE 500KV T/L
AND ALTERNATE ROUTES

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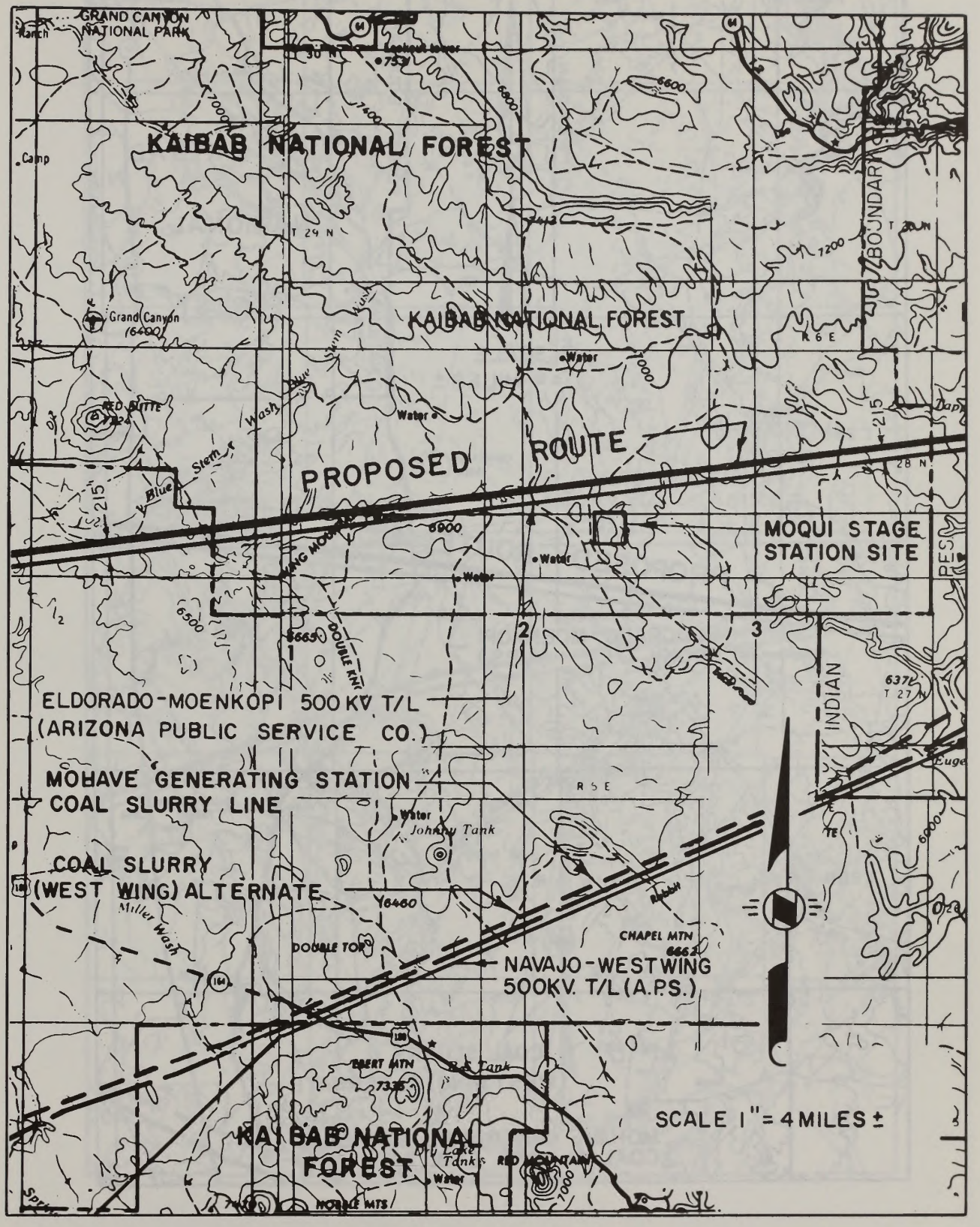
ILLUSTRATION 18C



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

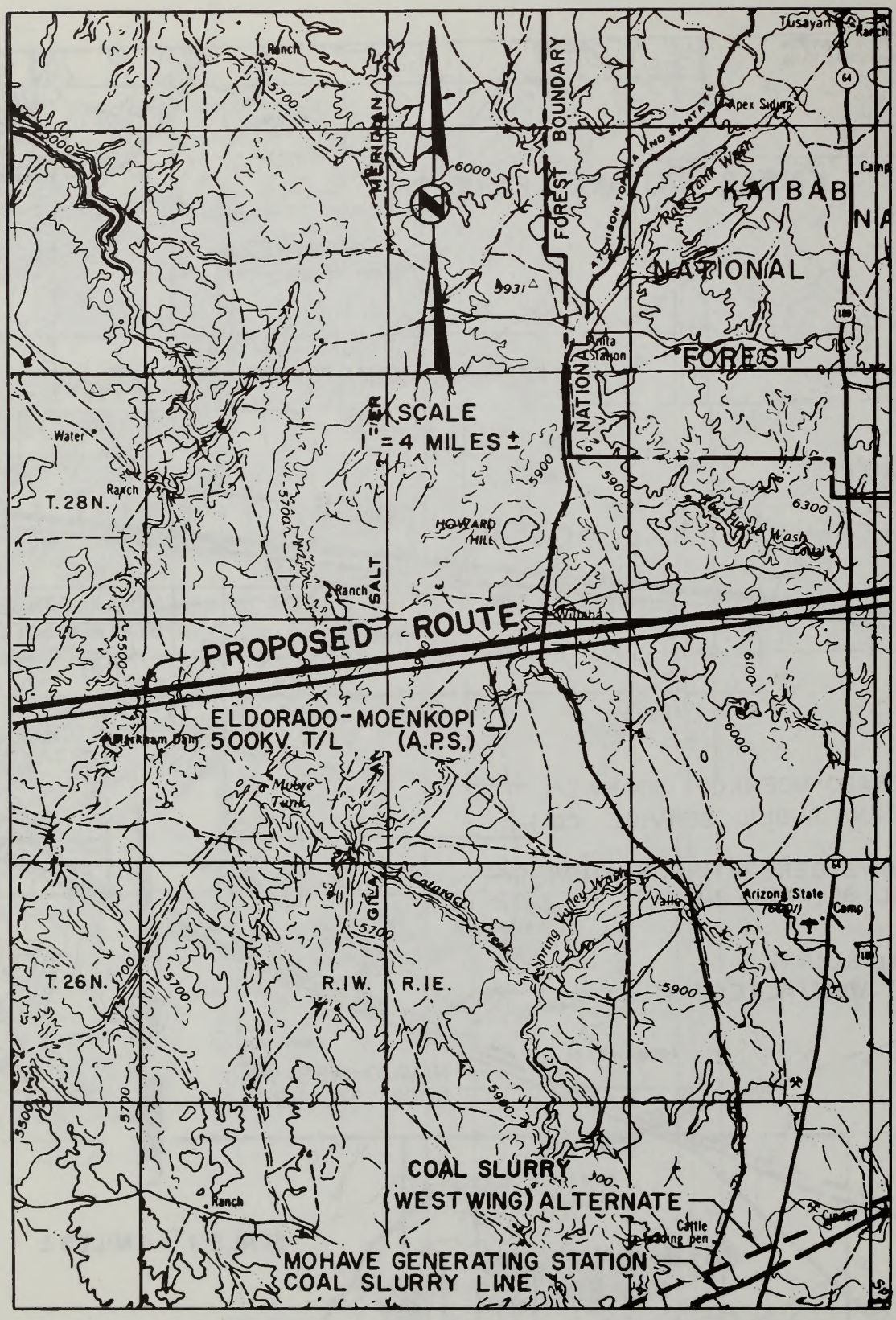
ILLUSTRATION 18 D



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

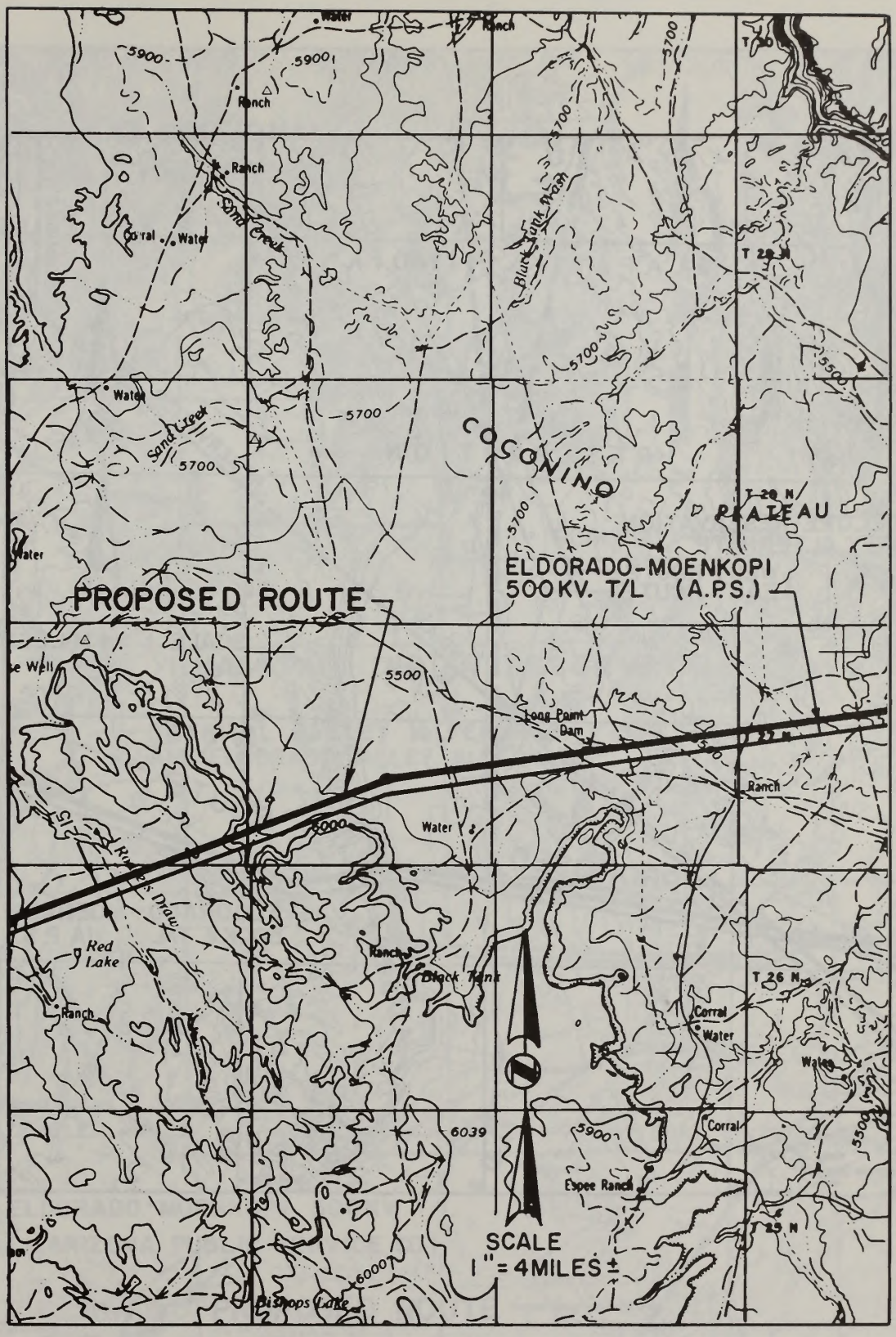
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KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

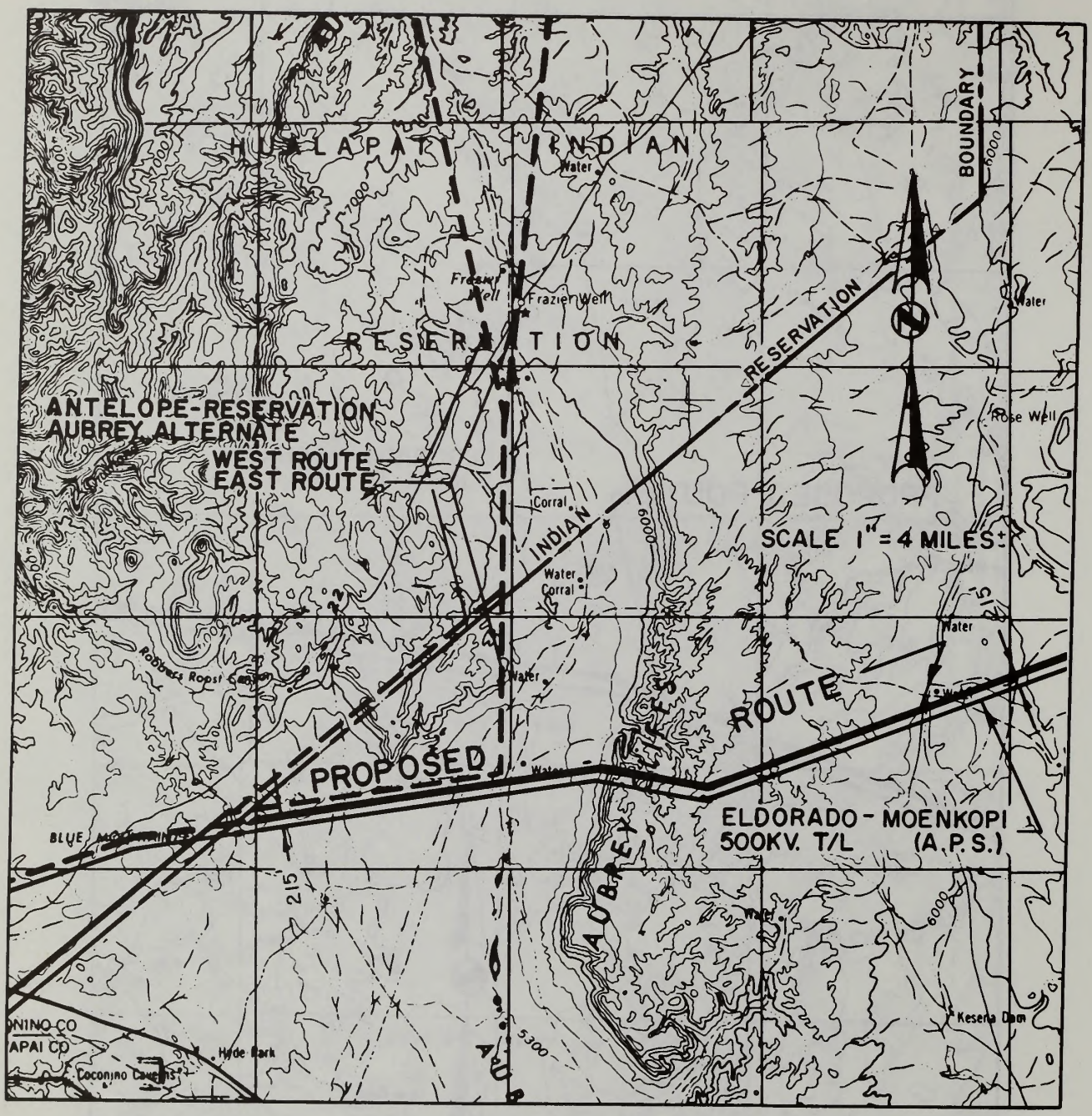
ILLUSTRATION 18 F



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

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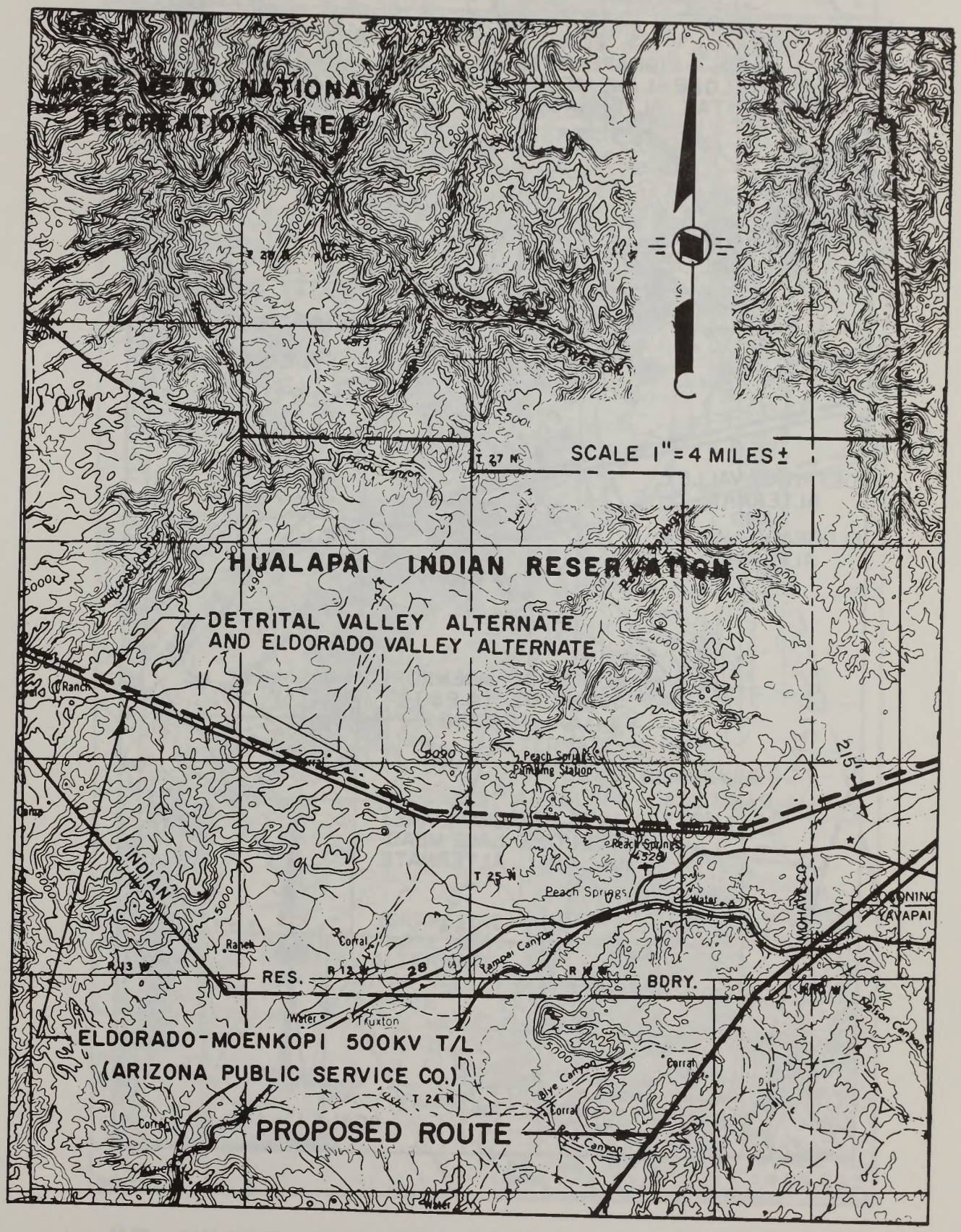
ILLUSTRATION 18 G



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
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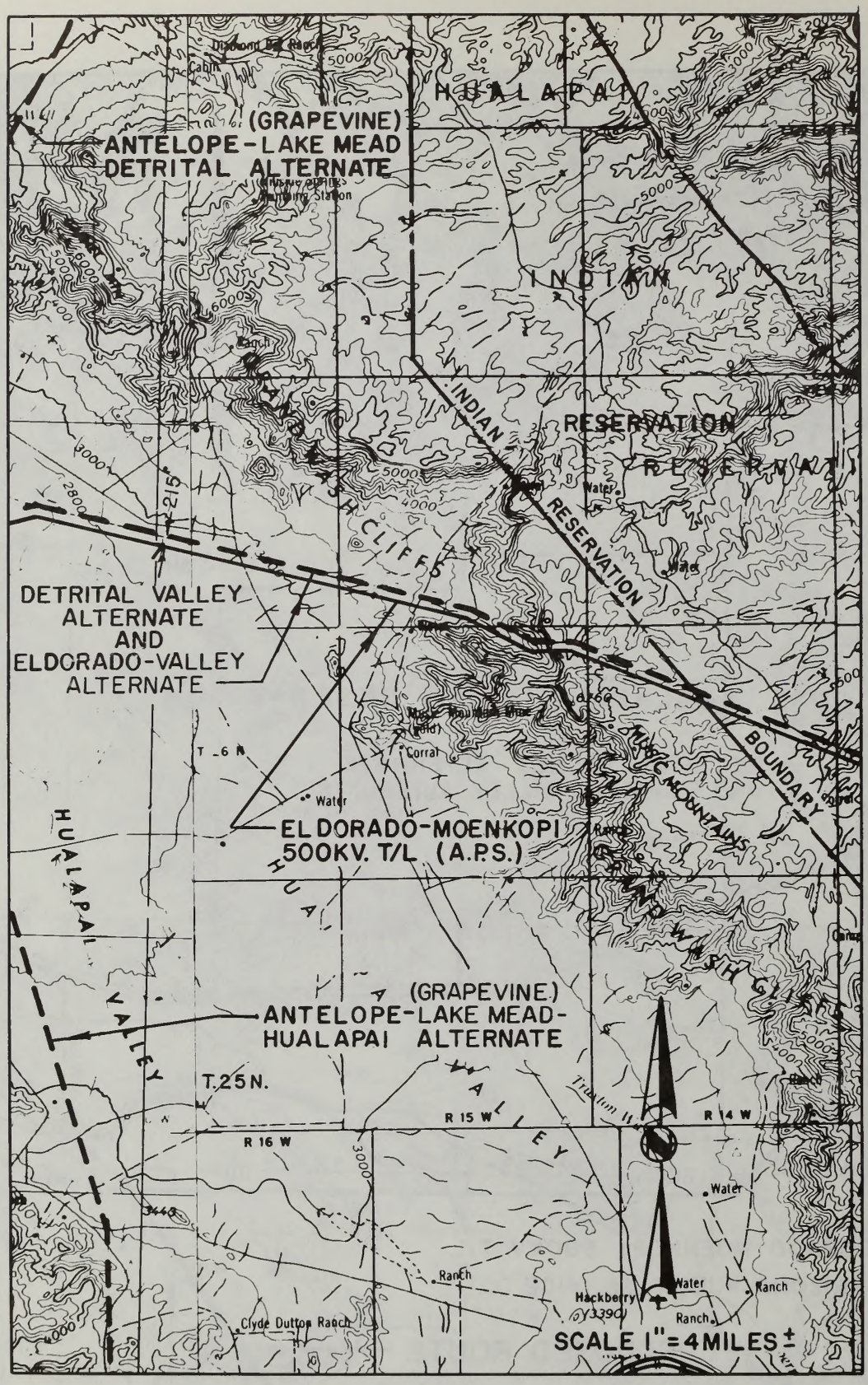
ILLUSTRATION 18 H



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

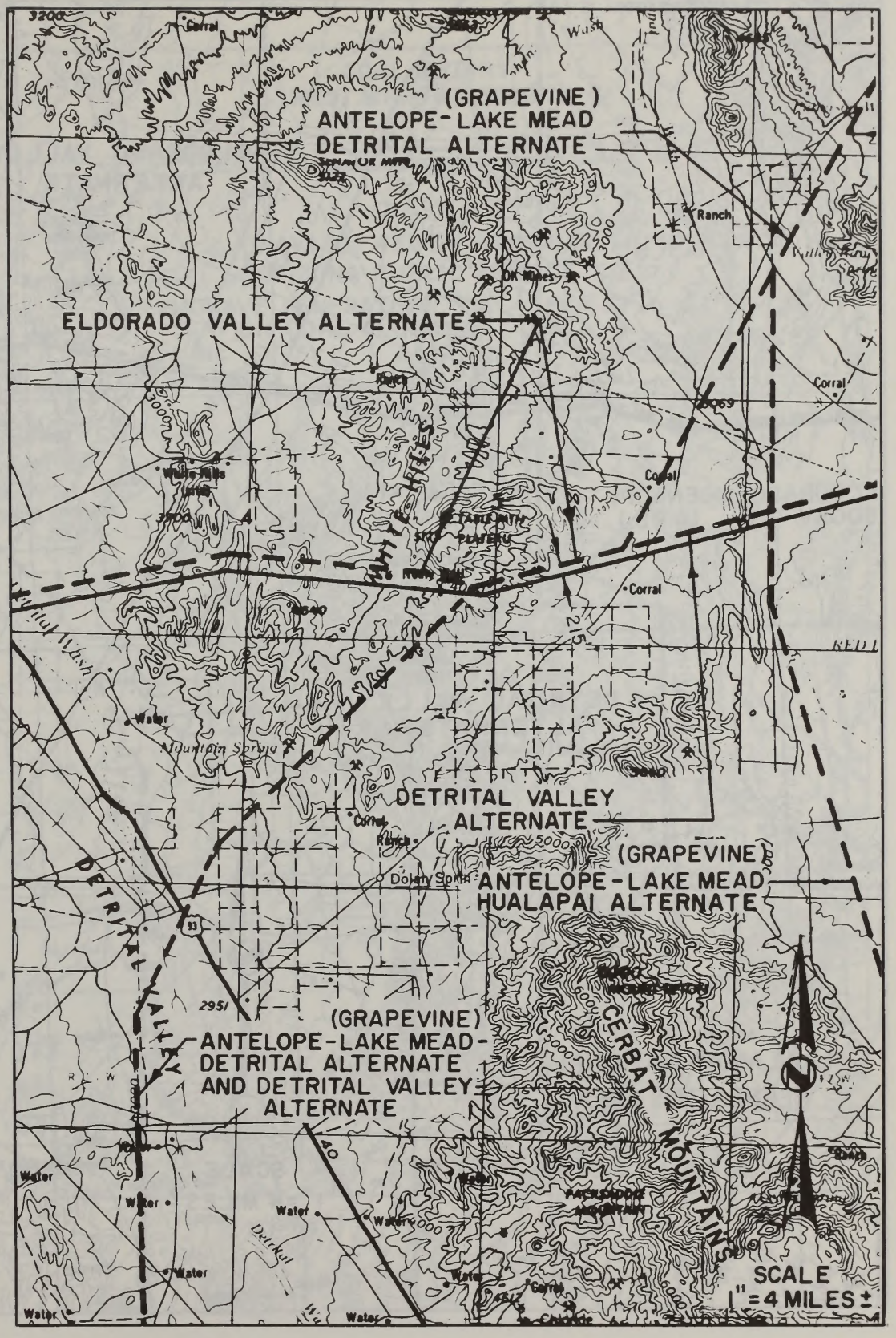
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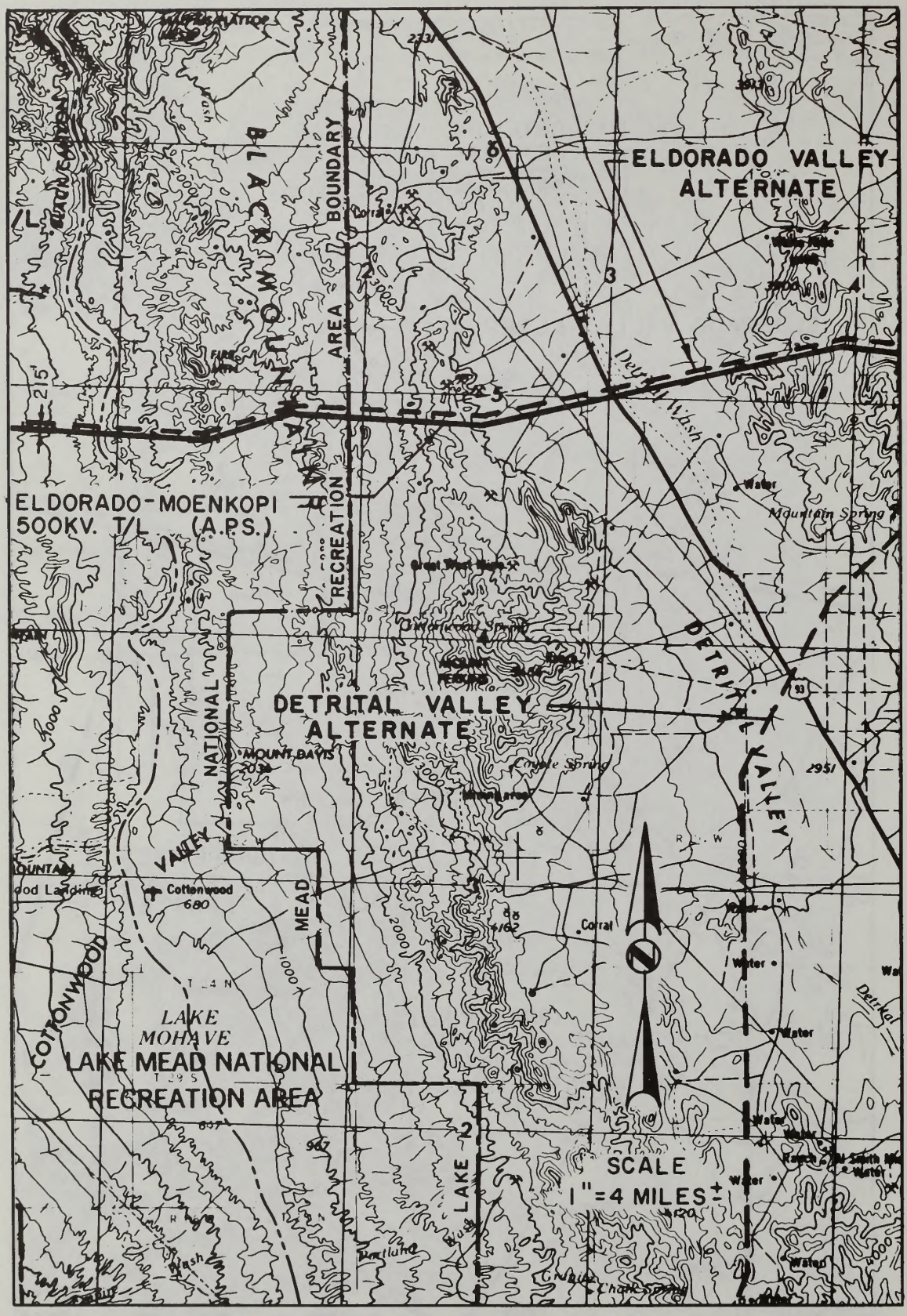
KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

ILLUSTRATION 18 J



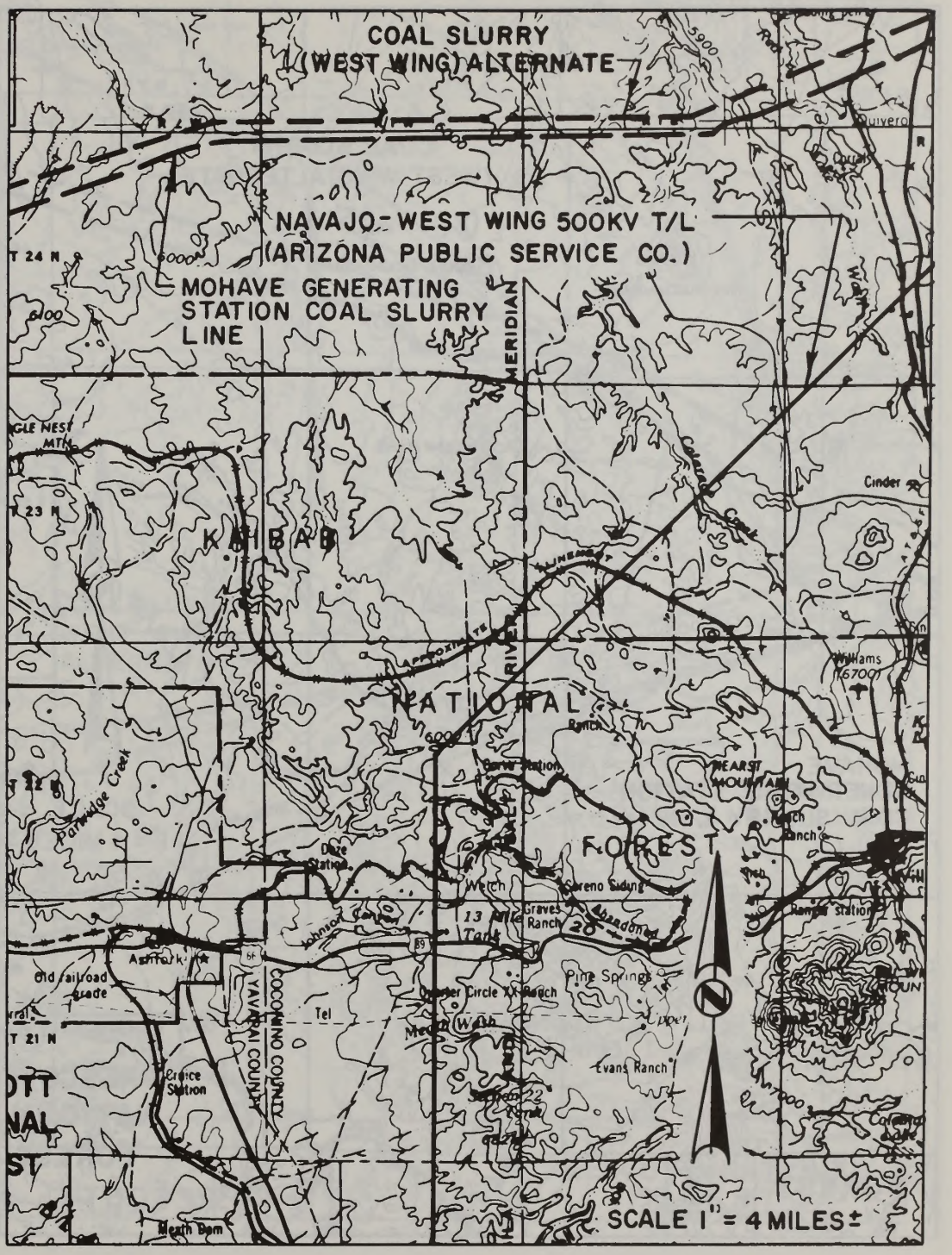
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AND ALTERNATE ROUTES



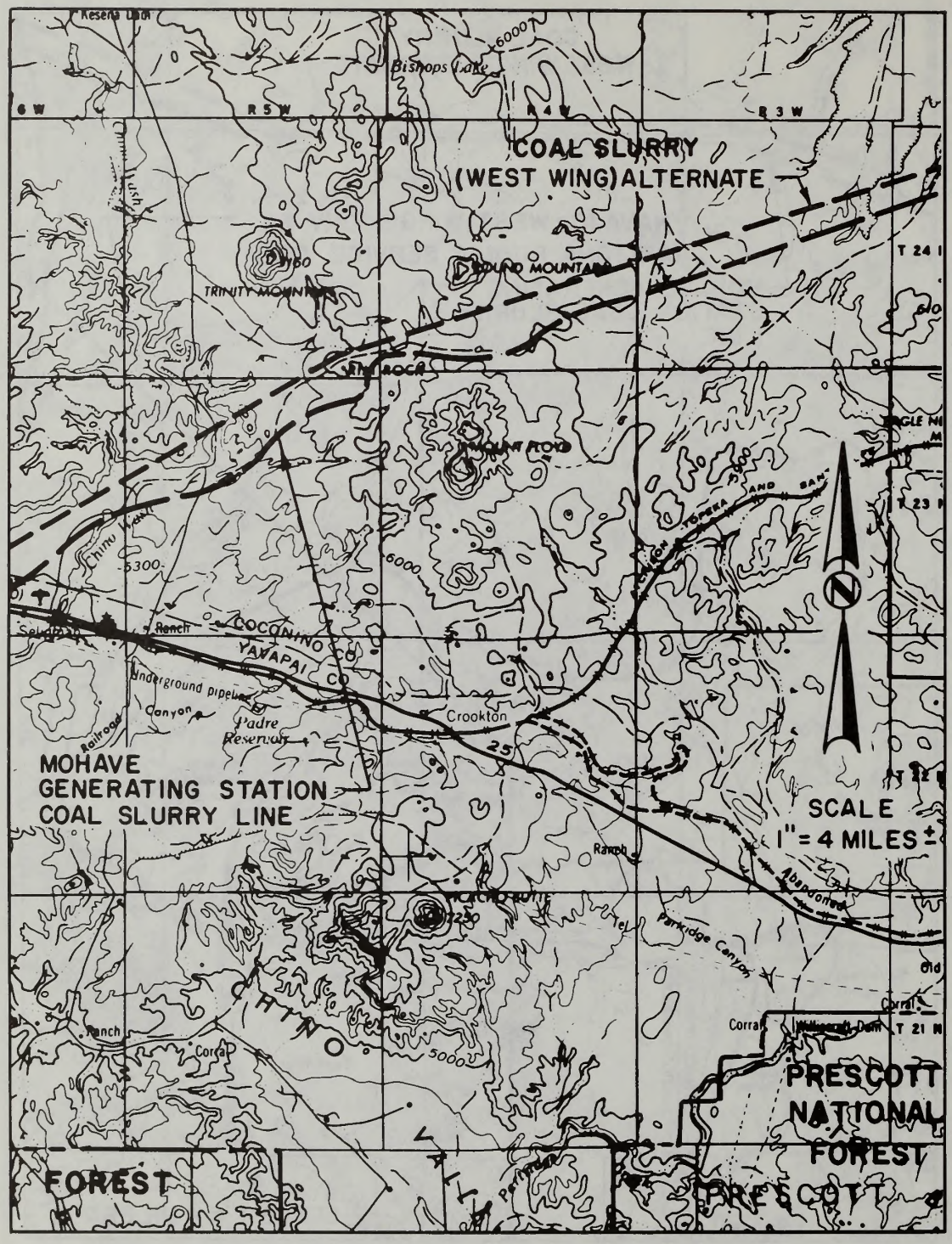
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4-9-75

ILLUSTRATION 18 L



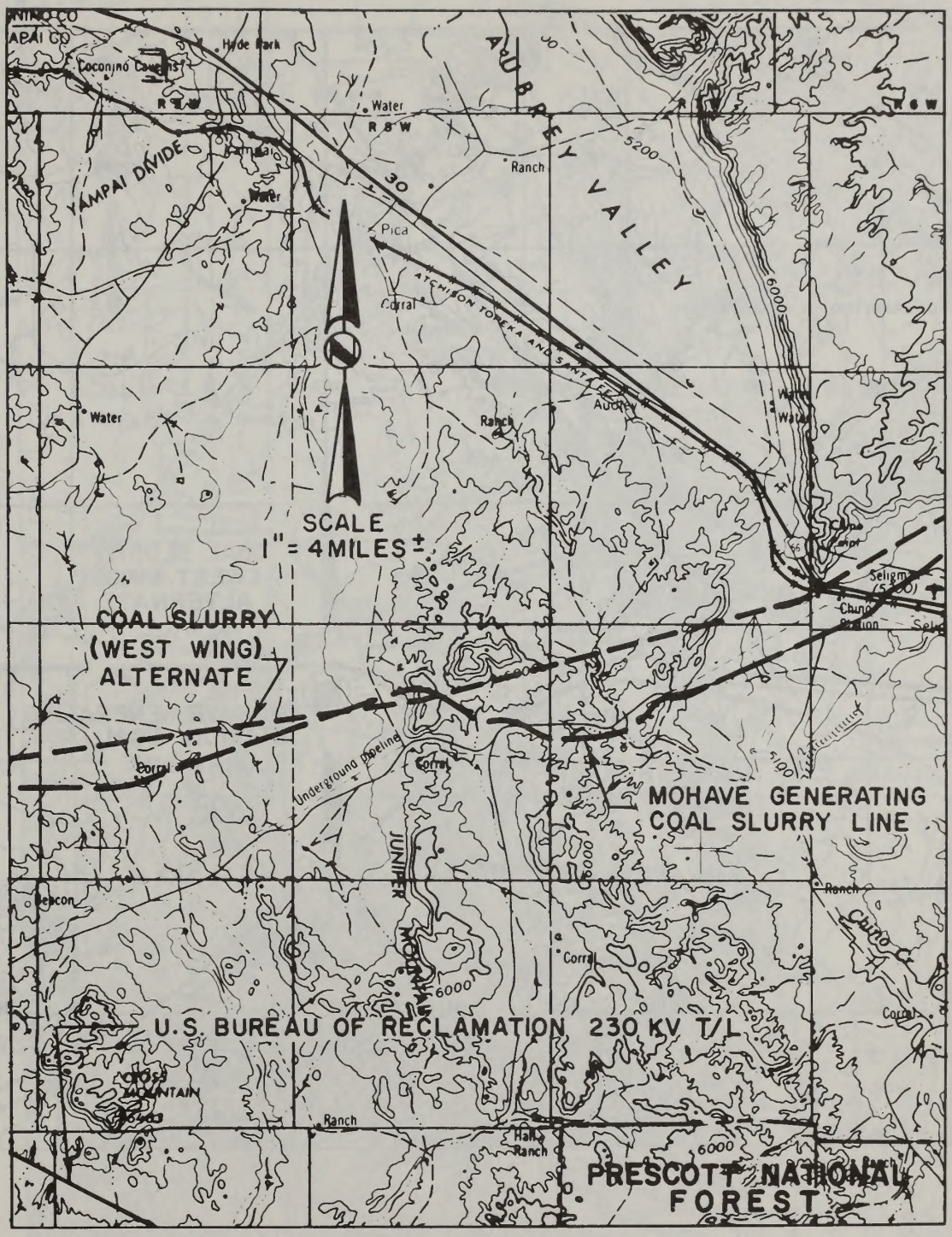
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AND ALTERNATE ROUTES

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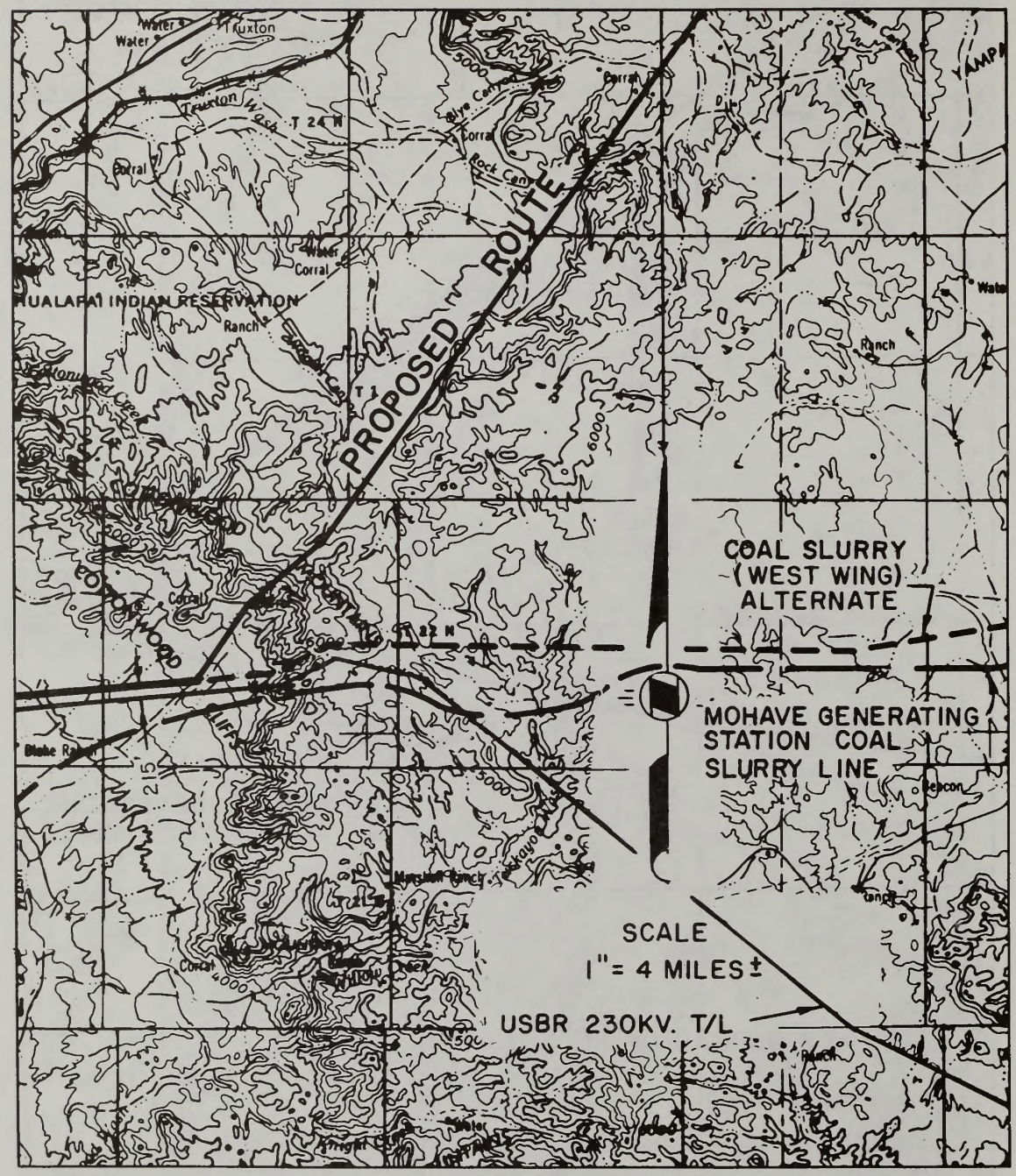
ILLUSTRATION 18 N



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

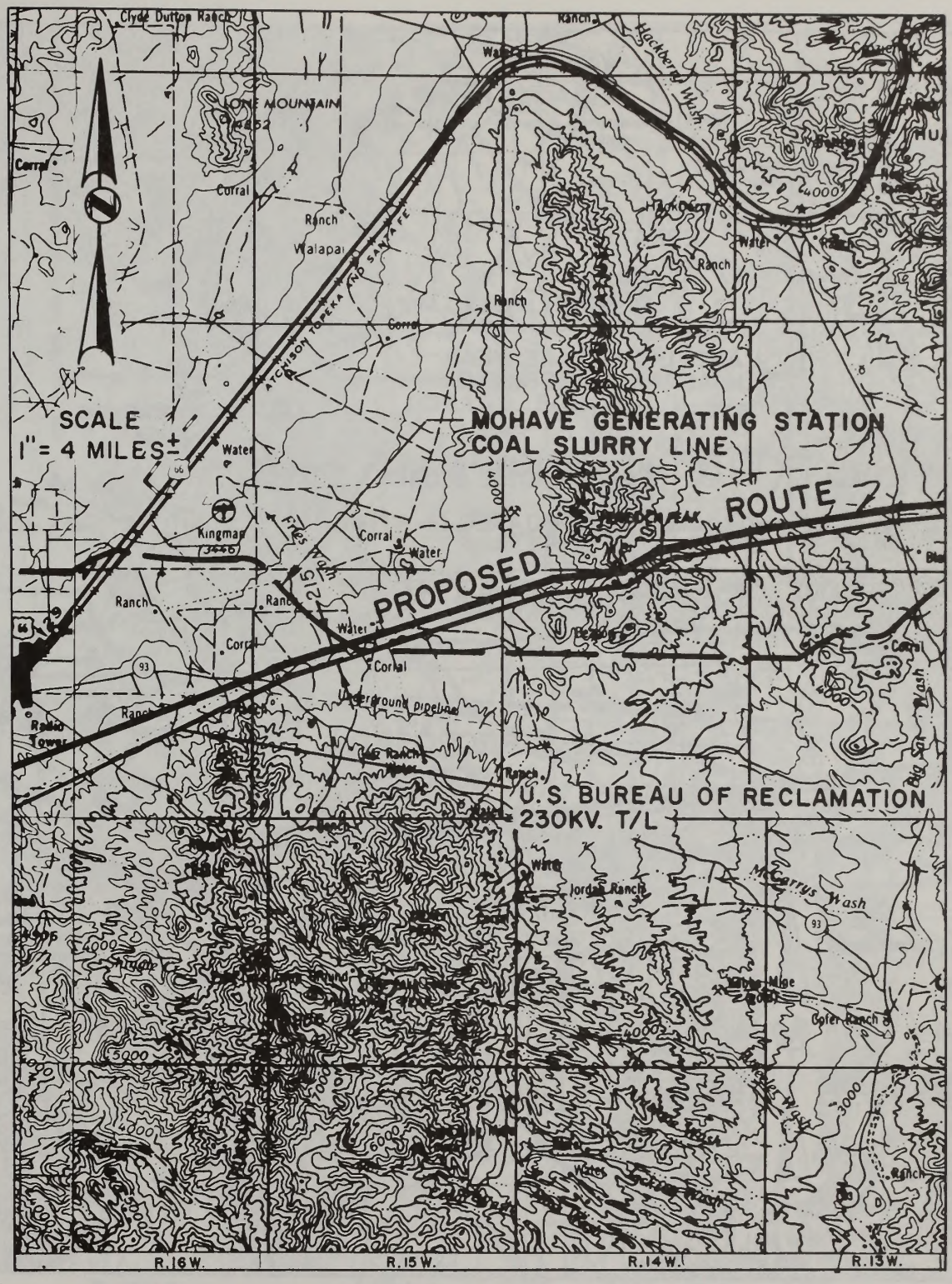
ILLUSTRATION 180



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L AND ALTERNATE ROUTES

4-9-75

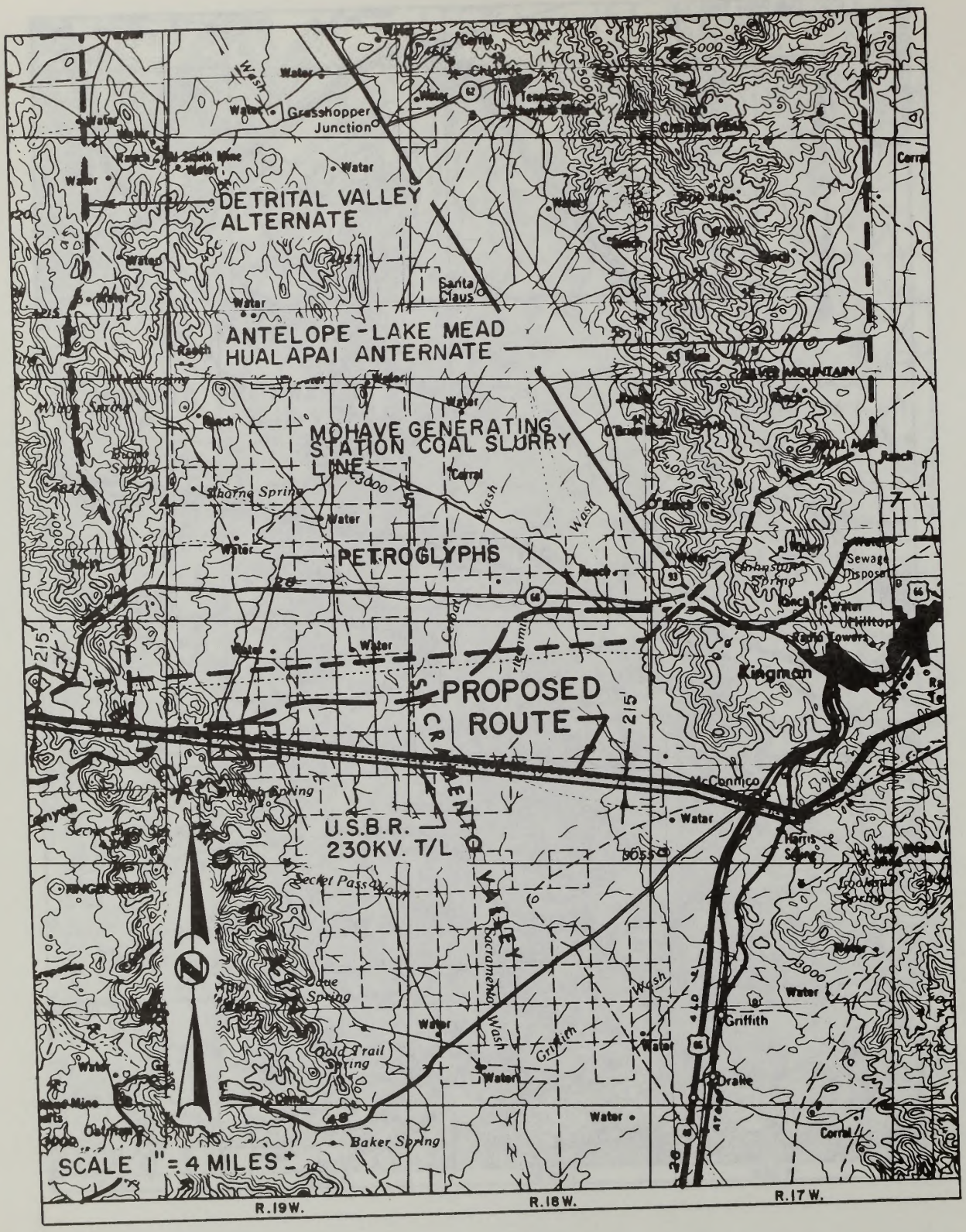
ILLUSTRATION 18 P



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L AND ALTERNATE ROUTES

4-9-75

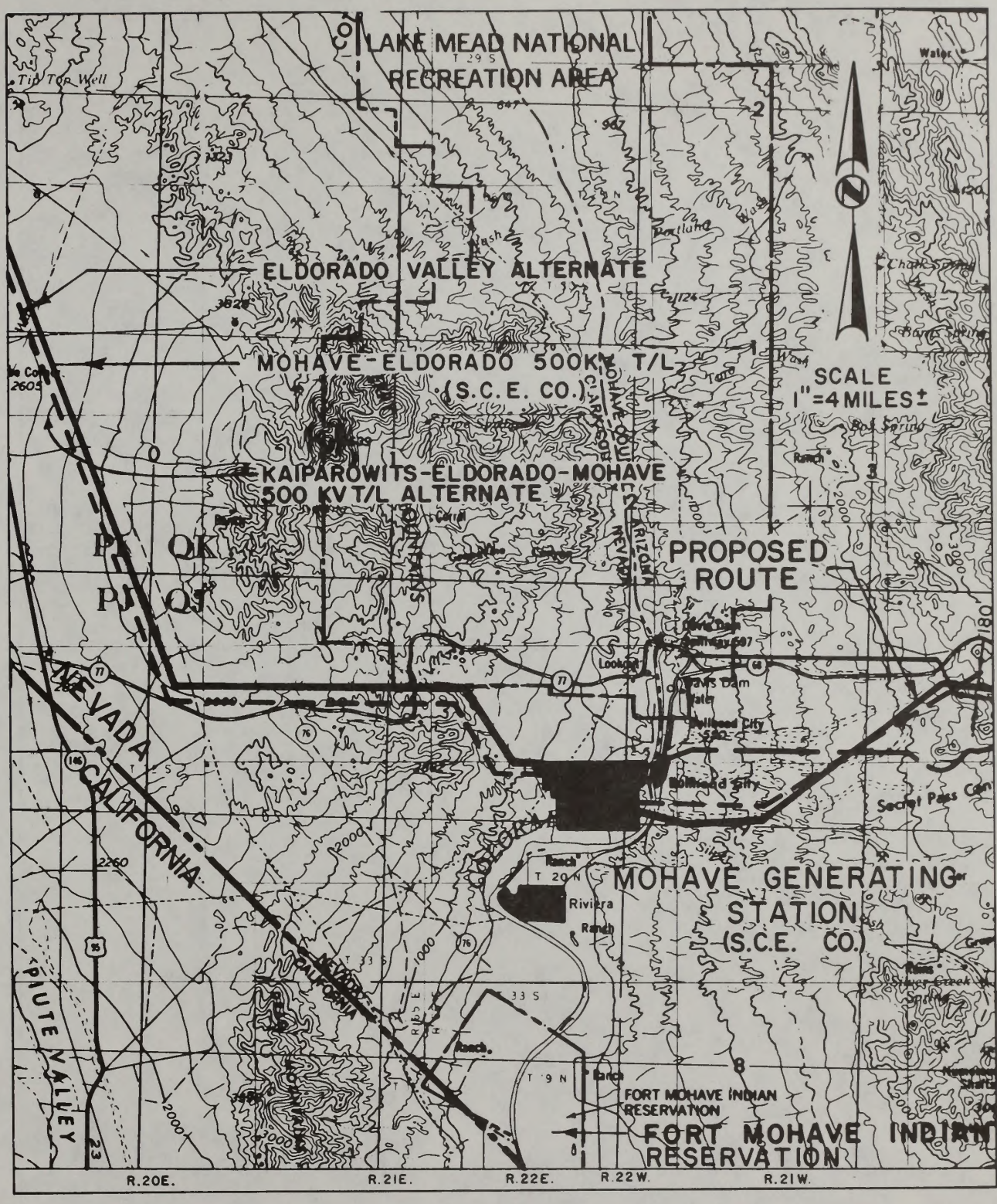
ILLUSTRATION 18 Q



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

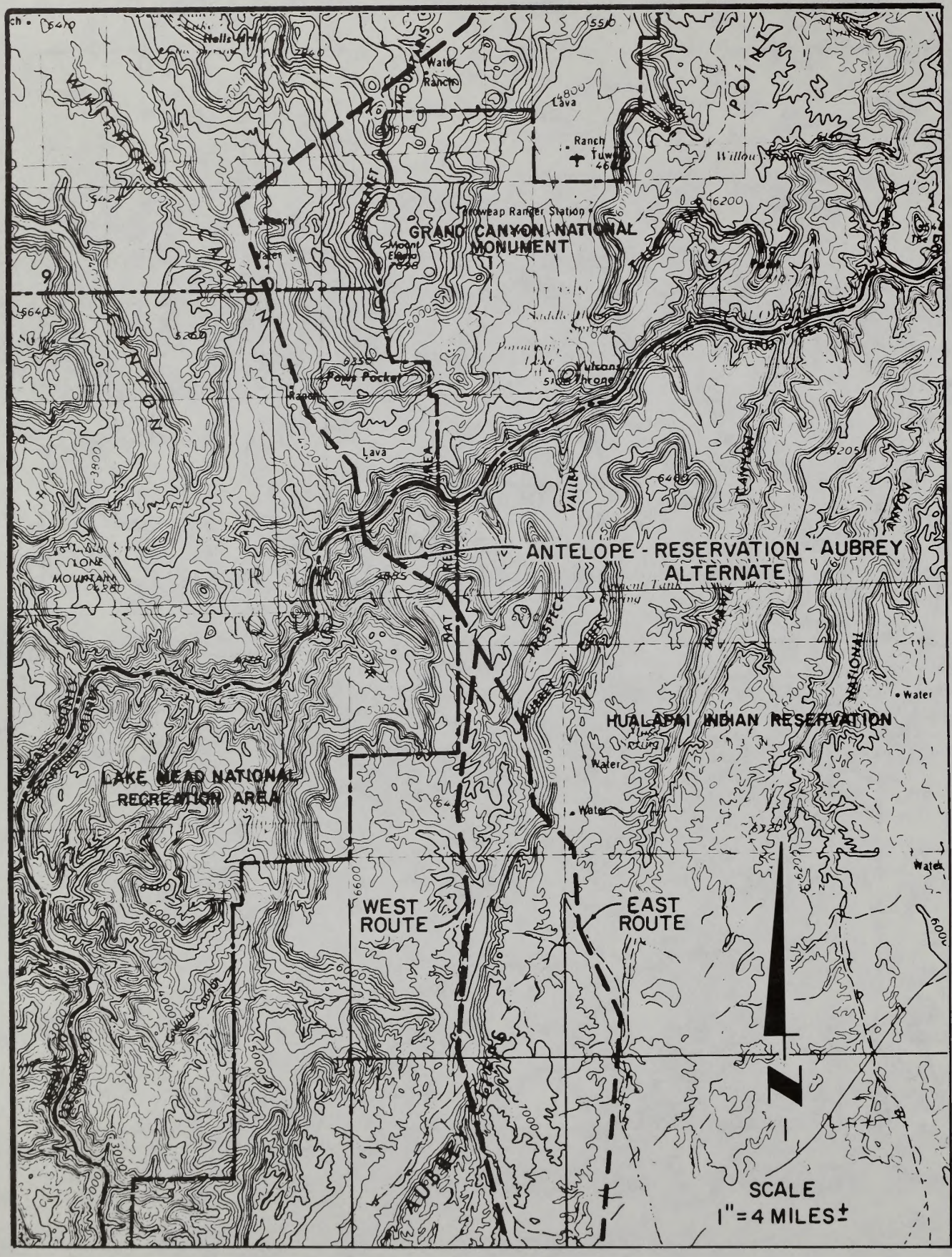
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KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

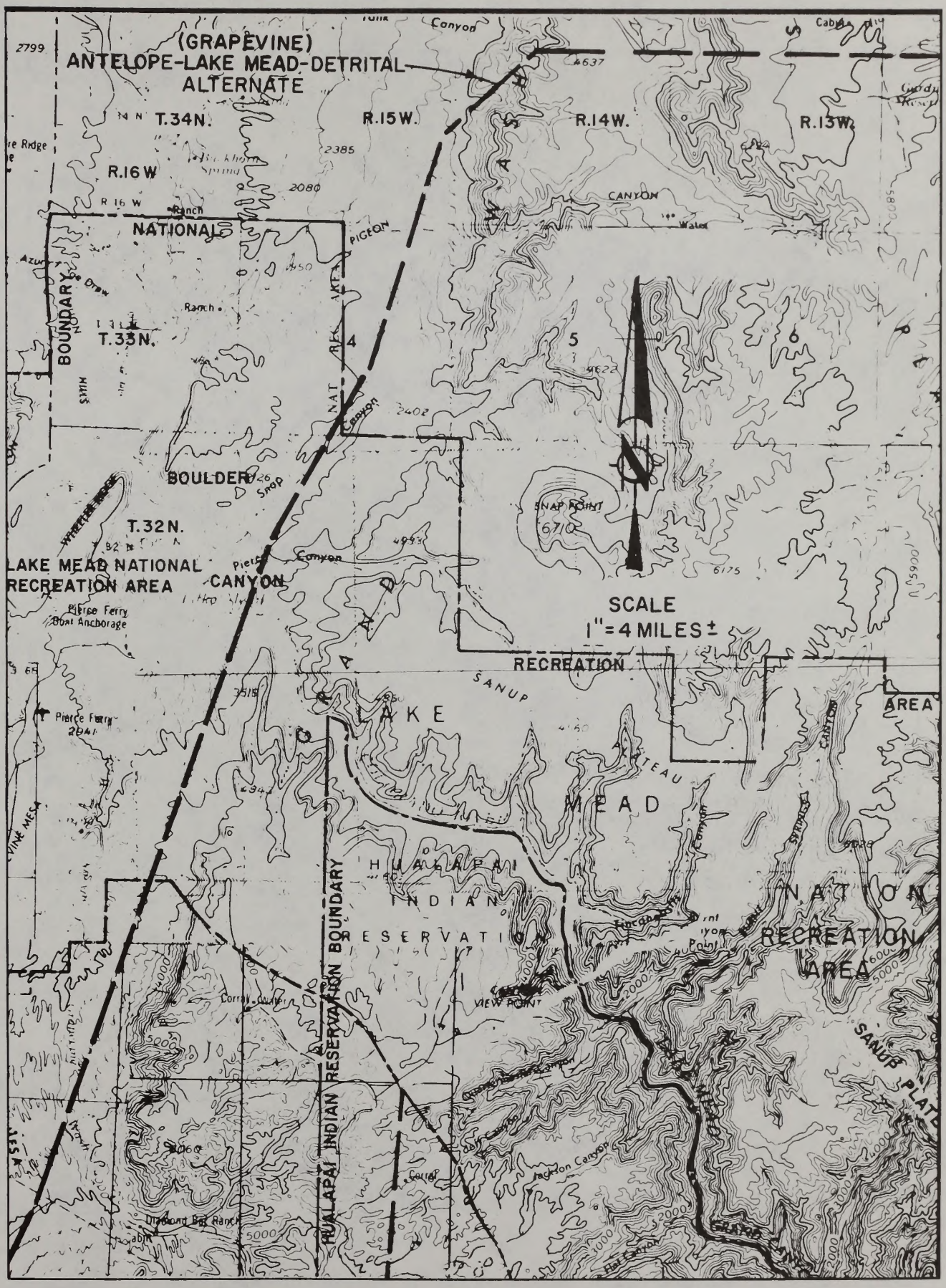
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ILLUSTRATION 18 S



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L AND ALTERNATE ROUTES

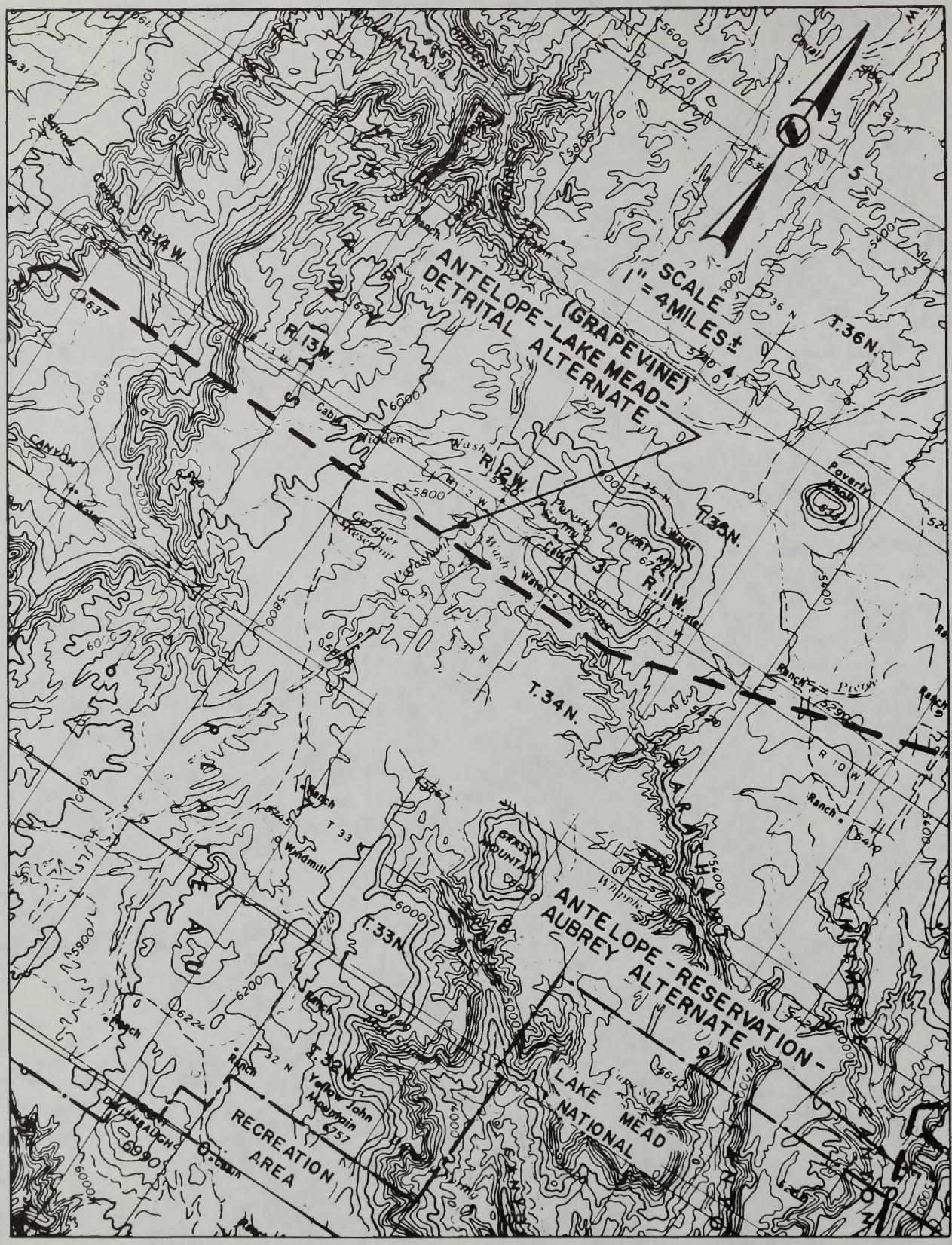
ILLUSTRATION 18 T



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

ILLUSTRATION 18 U



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

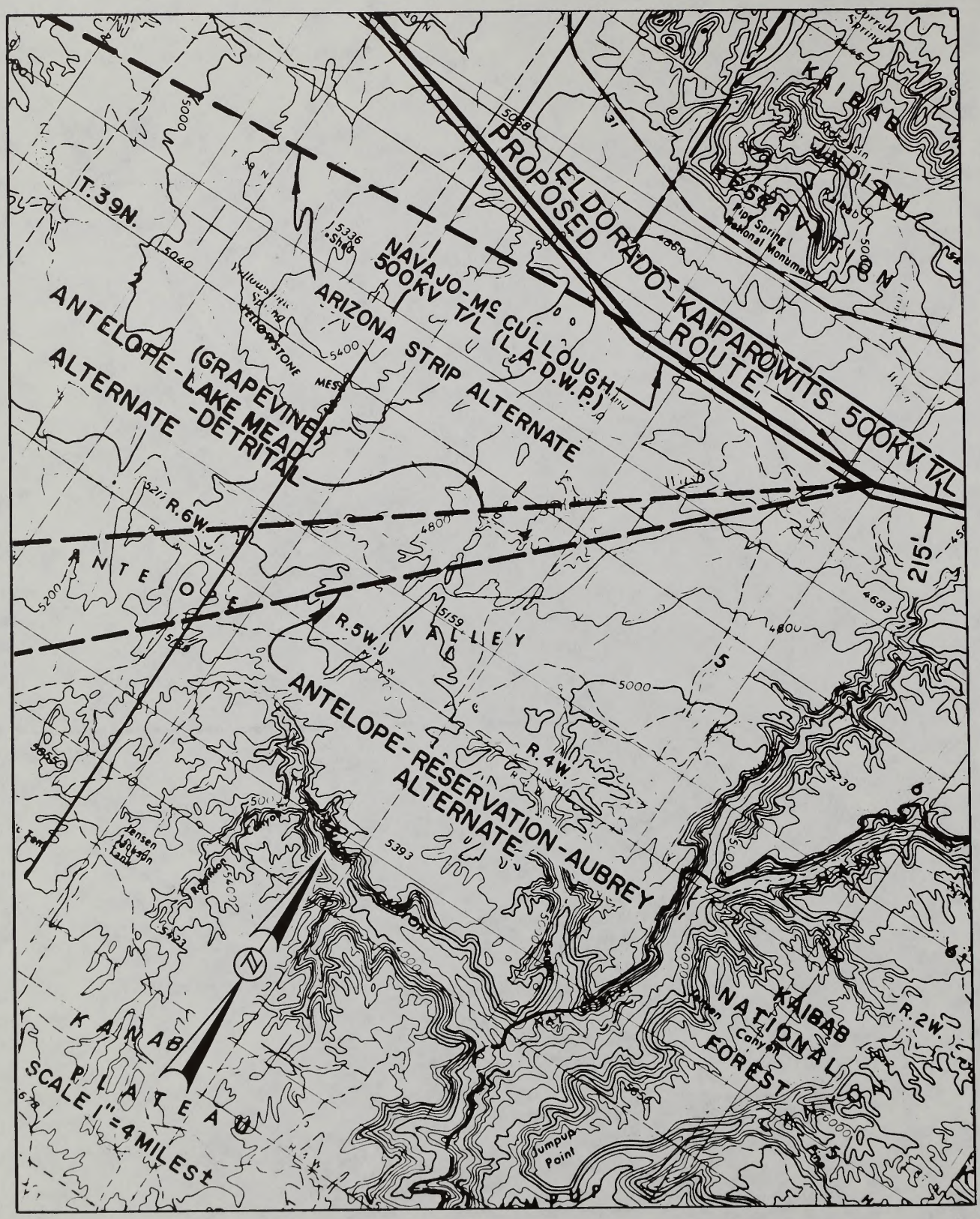
ILLUSTRATION 18 V



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

ILLUSTRATION 18 W



KAIPAROWITS - MOENKOPI - MOHAVE 500KV. T/L
AND ALTERNATE ROUTES

4-9-75

ILLUSTRATION 18 X

The route would bend almost due west for nine miles across rolling hills and parallel to U. S. Highway 66 for the first two miles of this section. The alternate would pass 2-1/2 miles north of the community of Peach Springs. Angling northwest for about 16 miles, the route would continue to the west boundary of Hualapai Indian reservation.

It then would continue northwest for three miles through the rugged Music Mountains, angle almost due west for about 1.5 miles and begin to drop from the mountains to the desert below. The route would angle sharply to the northwest for about two miles and descend Grand Wash Cliffs from an elevation exceeding 6,000 feet to an elevation of 4,000 feet. This vertical drop of 2,000 feet occurs in about three miles.

At the base of Grand Wash Cliffs, the route would bend west for 10.4 miles across Hualapai Valley and then angle southwest for 11.2 miles, skirting Red Lake. A few miles further west in the White Hills, this alternate would turn southwest and leave the APS line. The alternate would continue southwest for 9.3 miles, descending the White Hills toward U. S. Highway 93/466 and Detrital Valley. The route would angle farther southwest for about 4.5 miles, cross Detrital Wash and Highway 93/466. It would bend south for 12.4 miles ascending a long, wide draw that gradually narrows as it gains elevation. The route would jog southwest for about two miles, southeast for about 5.5 miles, and descend some steep cliffs to an elevation between 3,500 and 3,600 feet. The route would angle south for 4.6 miles, cross Arizona State Highway 68 and rejoin the proposed route. Length of this alternate would be 328 miles, 20 miles longer than the proposed route.

Description of the environment

This alternate would pass over a deeply buried salt bed near Red Lake in Hualapai Valley. There are plans to mine salt beneath Detrital Valley about 25 miles to the northwest, and it is likely that salt beneath Hualapai Valley will also be mined in the future. However, there are currently no leases or permits in the area.

This alternate would cross two proposed natural areas, Grand Wash Cliffs and Red Lake. The Grand Wash Cliffs area would include 50 miles from the Colorado River to the Music Mountains. The other natural area, Red Lake, is the only large playa in this part of Arizona. The lake represents a valuable area for study of a dry lake environment.

Aesthetic values along most of the Detrital Valley alternate have already been degraded by the existing 500 kv transmission line. After the alternate breaks away from the existing line, it would pass through an extensive area of large desert-lot residential subdivisions on both sides of Detrital Valley. Though there is very little opportunity for views of natural desert scenery in the valley or lower hills, higher elevations in the Black Mountain are relatively free of man-made intrusions, and have a greater variety of vegetation and terrain. The Black Mountains also support a herd of bighorn sheep.

Land use along this proposed alternate consists mostly of scattered, acre-estate residences in the White Hills and along both sides of Detrital Valley. Large parts of Detrital and Hualapai valleys have been sub-divided, but such areas are sparsel settled. The likelihood that these areas will ever be heavily populated seems remote.

Land use planning in the area of this alternate is the same as that for the proposed route. The Grand Wash Cliffs, where the existing transmission line crosses, is in the process of being designated by BLM as a "scenic area". Even though an existing line crosses this area, public opinion expressed through the BLM planning process revealed that no more lines should be built through this area.

Environmental impacts of alternate action

Another power line could restrict or prevent mining of salt beneath part of Hualapai Valley. Along with the existing APS line, construction of this alternate could later require large expenditures by some mining company to relocate the lines. At the very least, allowing the alternate could result in a strip several hundred feet wide across Hualapai Valley under which salt could not be mined.

Additional length (20 miles) of this alternate would cause permanent disturbance of 36 more acres of soil and vegetation than the proposed route. However, the alternate would create seven fewer miles of new corridor.

From the east boundary of Hualapai Indian Reservation to the White Hills, this alternate would be an additional intrusion to the scenery. High scenic impacts would occur along Grand Wash Cliffs. This alternate would also represent a new intrusion along the west side of Detrital Valley. Scenery of the Black Mountains, as viewed from the east, would suffer high impacts because the line would be visible to residents of Detrital Valley and motorists along Highways 68 and 93. The alternate would be more visible than the proposed route because the alternate follows the east side of Detrital Valley, for about 25 miles, while the proposed route crosses Detrital Valley for about 12 miles. The alternate could also cause residential property near the line in Detrital Valley to decrease in value.

Mitigating measures

Same as proposed route.

Any adverse effects which cannot be avoided should the proposal be implemented

This alternate could have one of two impacts on future mining of salt in Hualapai Valley: (1) two parallel lines would prevent mining salt beneath a strip several hundred feet wide across the valley; or (2) any company that did mine salt beneath this strip would have to spend large amounts of money to relocate the lines.

Although it would create seven fewer miles of new corridor than the proposed route, the alternate would permanently disturb an extra 36 acres of soil and vegetation. After mitigation, the line would still reduce scenic quality in Grand Wash Cliffs and along the west edge of Detrital Valley for 25 miles. The proposed route avoids the Grand Wash Cliffs and crosses Detrital Valley for only 12 miles. Finally, a transmission line along this alternate route could cause a decrease in value of residential property near the line in Detrital Valley.

Eldorado Valley alternate

Description of alternate action

This route would follow the Detrital Valley alternate to the White Hills. At this point the alternate would parallel the existing APS line to 10 or 12 miles west of the Colorado River where an existing Metropolitan Water District 230 kv steel tower transmission line crosses the APS line. Angling sharply to the southwest at this point, the alternate would parallel the 230 kv line through Eldorado Valley eventually meeting the existing SCE Mohave-Eldorado 500 kv line about five miles north of Searchlight, Nevada. The alternate would then parallel the Edison line to Mohave Generating Station. This route would be 364 miles long, 56 miles longer than the proposed route.

Description of the environment

This alternate would cross two areas known to be inhabited by desert bighorn sheep - the Black and Eldorado Mountains. Eldorado Valley is crucial habitat for Gila monster and desert tortoise.

Areas surrounding the Colorado River where this alternate would cross have potential for archaeological discoveries. Access to this area is somewhat limited and there is a good chance that existing sites may yet be undisturbed.

The Eldorado Valley alternate would enter Lake Mead National Recreation Area on the west side of the Black Mountains and leave it a few miles west of the Colorado River. Landscape in this area consists of rugged, desert scenery. The only intrusion in this area is the existing APS 500 kv line. It has been proposed that lands north of this line within Lake Mead NRA be considered for wilderness area status.

This alternate would cross near Searchlight, Nevada in Clark County. The population of Searchlight is a few hundred people; the rest of this area is sparsely populated.

Environmental impacts of alternate action

Although this alternate would follow an existing line, improved access along the alternate could result in increased harassment of bighorn sheep in the Black and Eldorado Mountains and desert tortoise and Gila monsters in Eldorado Valley. The proposed route would avoid Eldorado Mountains and Eldorado Valley.

Undiscovered archaeological sites along the Colorado River could undergo slight disturbance or complete destruction during construction along the proposed alternate. In addition, improved access to this part of the Colorado River could result in further losses of archaeological sites.

Although there are existing lines the entire length of the proposed alternate another line would further reduce scenic quality as viewed from boats on Lake Mohave. The alternate would also further reduce natural values of the Lake Mead NRA. The proposed route would not cross the Lake Mead NRA.

Construction of this alternate would cause a decrease in residential property values near Searchlight or other areas in Eldorado Valley. On the other hand, construction workers would temporarily increase revenues to Clark County and Searchlight merchants.

Mitigating measures

Grantee would not permanently upgrade existing access in the Black Mountains, Eldorado Mountains, or Eldorado Valley. This measure should protect bighorn sheep, Gila monster, and desert tortoise habitat, and archaeological sites by maintaining restricted access.

Any adverse effect which cannot be avoided should the proposal be implemented

Loss of archaeological sites resulting from construction disturbance could not be mitigated. Construction along the proposed route near the Colorado River would be in an already disturbed area.

A transmission line along this alternate would be highly visible to boaters

on Lake Mohave. In addition, the alternate would reduce natural values of part of the Lake Mead NRA.

A transmission line through Eldorado Valley could cause a decrease in residential property values, especially near Searchlight or other areas that might be subdivided.

Coal slurry alternate

Description of alternate action

This alternate would follow the proposed route to Moenkopi Substation. From here the route would turn southwest for 35 miles following the APS Navajo to Westwing 500 kv lines. North of Williams, the alternate would join the Black Mesa Pipeline that carries coal slurry to the Mohave Generating Station. The route would more or less follow this right-of-way to Seligman. The alternate would meet an APS 230 kv line west of Seligman and continue west, veering away from the existing line, still more or less following the coal line. Near Cottonwood Mountains, the alternate would meet and follow the APS Davis to Prescott 230 kv line. The alternate would rejoin the proposed route at the base of Cottonwood Cliffs. This route would be 303 miles long, five miles shorter than the proposed route.

Description of the environment

Much of this alternate would cross flat topography that is not unique scenery. This contrasts somewhat with the proposed route which would cross several cliffs or rims and a 30-mile segment of scenic country southwest of Nelson, Arizona. For its entire length, this alternate would more or less follow one or more utility rights-of-way.

Environmental impacts of alternate action

For 50 miles northeast of Seligman, the alternate would follow the coal slurry pipeline. The alternate would create a new scenic intrusion along this segment;

however, most of this segment is relatively inaccessible and would not be viewed by the general public. An exception is Highway 64 between Williams and Grand Canyon. This would be a new crossing of the highway which would result in high impact on scenery. The alternate would also cross Highway 180 between Flagstaff and Grand Canyon. At this crossing, the alternate would be adjacent to two transmission lines and the addition of a third line would cause little additional scenic impact. This alternate would also be visible from Highway 66 and Interstate 40 near Seligman. Although it would create about 54 more miles of new transmission line corridor than the proposed route, the alternate would more or less follow existing utility corridors its entire length.

Mitigating measures

Same as proposal.

Any adverse effects which cannot be avoided should the proposal be implemented

Scenic impacts at highway crossing cannot be totally mitigated. Although it would create a new transmission line corridor for 54 more miles than the proposed route, the alternate would more or less follow utility rights-of-way its entire length. The proposed route would create 32 miles of new utility corridor.

Antelope-Reservation-Aubrey alternate

Description of alternate action

This alternate would follow the proposed route for 24 miles to the LADWP Navajo-to-McCullough line and would then turn west along the LADWP line to the proposed Kaiparowits to Eldorado route. The alternate would follow the proposed Kaiparowits to Eldorado route for 40 miles and turn south for 100 miles to rejoin the proposed Kaiparowits to Mohave route near the Hualapai Indian Reservation. The last 100-mile segment was described in the narrative for the Antelope-Hualapai alternate to the

proposed Kaiparowits to Phoenix route. The Antelope-Reservation-Aubrey alternate would be 280 miles long.

Description of the environment

The environment along this alternate is the same as the environment along the Antelope-Hualapai alternate to the proposed Kaiparowits to Phoenix route.

Environmental impacts of alternate action

Permanenent soil and vegetation losses along this alternate would be about 50 acres less than along the proposed route because this alternate would be 28 miles shorter than the proposed route. However, the alternate would create 70 more miles of new corridor than the proposed route. This new corridor would cross relatively undisturbed lands. Other impacts resulting from this alternate would be identical to the Antelope - Hualapai alternate to the proposed Kaiparowits to Phoenix route.

Mitigating measures

Same as Kaiparowits to Mohave and Kaiparowits to Westwing.

Any adverse effects which cannot be avoided should the proposal be implemented

Construction of a transmission line along this alternate would result in permanent disturbance of about 50 fewer acres than the proposed route; however, the alternate would create about 70 more miles of new corridor than the proposed route. Other unavoidable impacts resulting from this alternate were discussed in the Antelope - Hualapai alternate for the Kaiparowits to Phoenix proposed route.

Antelope - Lake Mead - Detrital alternate

Description of alternate action

This alternate would follow the proposed Kaiparowits to Eldorado route for 71 miles over the northern Coconino Plateau, and then turn southwest, leaving the Kaiparowits to Eldorado route in Antelope Valley directly south of the Kaibab Indian

Reservation. After crossing north of Mt. Trumbull, the alternate would cross Grand Wash Cliffs, Hurricane Cliffs, Whitmore Canyon, the eastern edge of Lake Mead, and finally connect with the proposed Detrital Valley alternate at the east edge of the White Hills. From here this alternate would follow the Detrital Valley alternate to the proposed Kaiparowits to Moenkopi to Mohave route. This alternate would be 250 miles long.

Description of the environment

This alternate would cross 125-miles of remote, undeveloped lands. The alternate route would cross 50 miles of pinyon-juniper vegetative community versus 60 miles for the proposed route. It would cross Joshua tree woodland and desert bighorn sheep habitat south of Lake Mead NRA on Grapevine Mesa. The alternate would also cross lands in the Lake Mead NRA that have been proposed for wilderness status. For 125 miles, the alternate would cross undisturbed lands, some of which are quite scenic. These include the Grand Wash and Hurricane Cliffs.

Environmental impacts of alternate action

The alternate would reduce the natural and scenic values of 125 more miles of undisturbed land than the proposed route. In addition, the alternate would reduce the natural and scenic values of Grand Wash and Hurricane Cliffs, a proposed wilderness area within Lake Mead NRA, and an area of Joshua tree woodland somewhat unique to Arizona. The alternate would result in permanent disturbance of 104 fewer acres than the proposed route because the alternate would be 58 miles shorter.

Mitigating measures

Same as proposed route.

Any adverse effects which cannot be avoided should the proposal be implemented

The alternate would create 125 more miles of new corridor than the proposed route, although it would result in 104 fewer acres permnanently disturbed. The

alternate would reduce scenic and natural values in a proposed wilderness area, an area of vegetation somewhat unique to Arizona, and areas of rugged cliffs and rims. The proposed route avoids such areas.

Antelope - Lake Mead - Hualapai alternate

Description of alternate action

This alternate would follow the Antelope - Lake Mead - Detrital alternate to the north end of Hualapai Valley and then turn south along the east edge of the Cerbat Mountains. Six miles north of Kingman this alternate would turn southwest across the south end of the Cerbat Mountains. The route would continue west across Sacramento valley and rejoin the proposed route near Secret Pass in the Black Mountains. This route would be 250 miles long.

Description of the environment

The alternate would cross parts of northern Hualapai Valley that are underlain by deep salt deposits. This resource was discussed in detail in the Detrital Valley alternate.

The route would cross relatively undisturbed land in Hualapai Valley and the Cerbat Mountains. No lines currently occupy this alternate, and it would not follow utility corridors established through BLM planning. The route would pass several miles north and east of Kingman, Arizona which appears to be growing in these directions.

Environmental impacts of alternate action

Impacts resulting from the Detrital Valley and Antelope - Lake Mead - Detrital alternates would also result from this alternate. The alternate would create a new corridor, 154 miles longer than the proposed route. About 50 miles of this new corridor would cross the Cerbat and Black Mountains planning units where utility corridors have at least been tentatively identified. Surface disturbance would be

104 acres less than on the proposed route.

The presence of a power line along this alternate route could reduce land values in areas where future residential development is likely. One such area is north and east of Kingman, Arizona near the Cerbat Mountains. The other area is located in northern Sacramento Valley which is partially subdivided. At present no homes are actually located on the alternate route proposal.

Mitigating measures

Same as proposed route.

Any adverse effects which cannot be avoided should the proposal be implemented

In addition to creating 154 more miles of new corridor than the proposed route, the alternate would cross an area where utility corridors have been tentatively identified through BLM planning. Permanently disturbed areas resulting from the alternate would be about 104 acres fewer than the proposed route. Transmission lines along the alternate could reduce land values north and east of Kingman and in northern Sacramento Valley.

Impact evaluation

An impact evaluation of all alternate transmission system routes for the proposed Kaiparowits to Moenkopi to Mohave segment is contained in Figure 6.

Mohave to Serrano (Illustrations 19 to 19g)

Sheephole Pass alternate

Description of alternate action

This alternate would follow the proposed route from the Mohave Generating Station for about 28 miles to approximately three miles north of Camino Substation. The alternate would then leave the proposed route and continue southwest across the M.W.D. 220 kw power line and U. S. Highway 66. Continuing southwest, it would pass through Fenner Valley crossing the Atchison-Topeka-and Santa Fe Railroad right-of-way

FIGURE 6

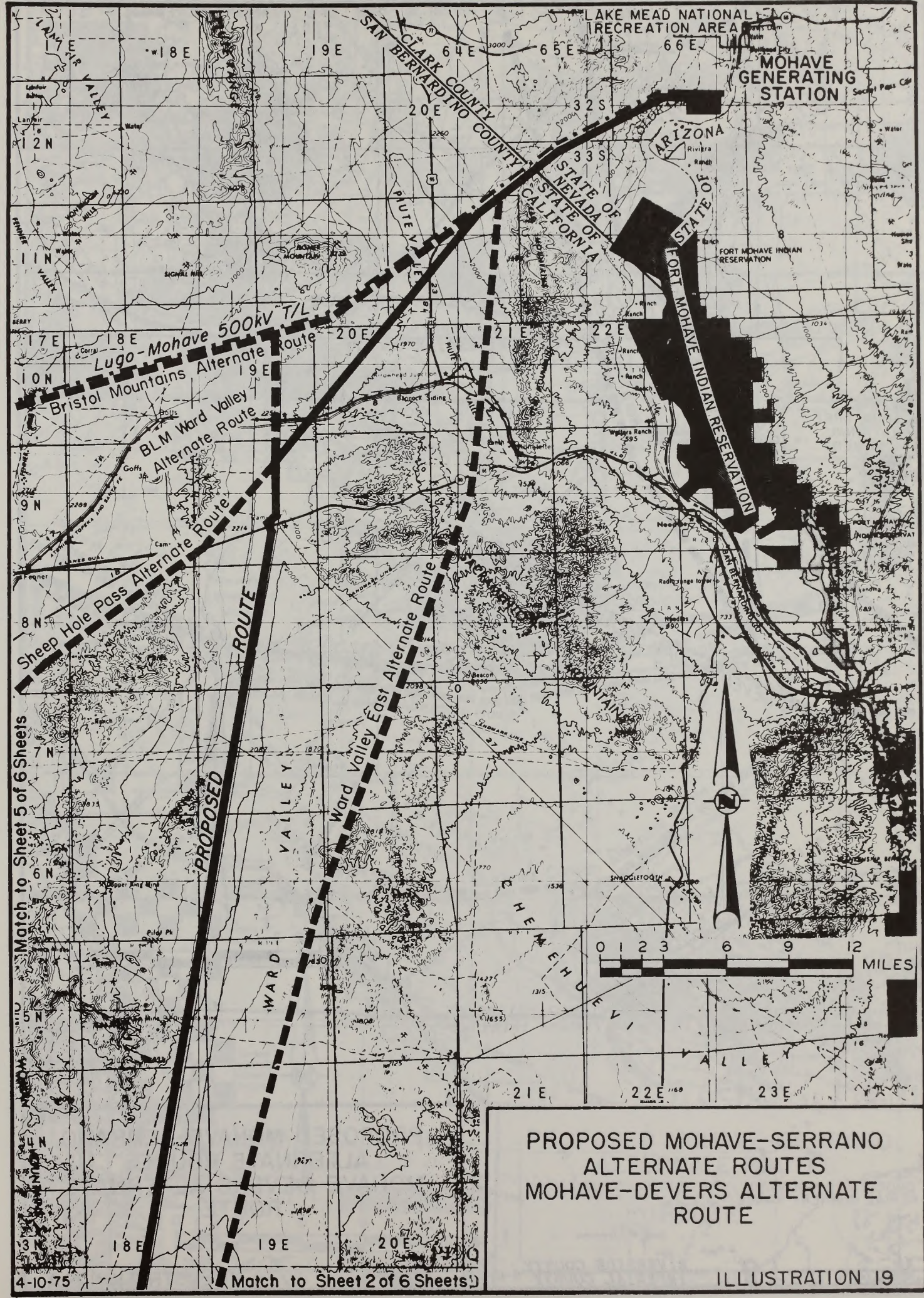
Impact Evaluation of Alternate Routes for Proposed Kaiparowits to Moenkopi to Mohave Route[a]

		Importance to decision making[b]	John Henry Alternate	West Alternate	Cedar Ridge Alternate	Detrital Valley Alternate	Eldorado Valley Alternate	Coal Slurry Alternate	Antelope-Reservation Aubrey Alternate	Antelope-Lake Mead-Detrital Alternate	Antelope-Lake Mead-Hualapai Alternate
Mileage (more or less than proposed route)		5	+3	+2	+ 2	+20	+56	-5	-28	-58	-49
Climate		1			N-N	N-N	N-N	N-N	N-N	N-N	N-N
Air Quality		1			S-S	S-S	S-S	S-S	S-S	S-S	S-S
Geology and Topography	General	1			N-N	N-N	N-N	N-N	N-N	N-N	N-N
	Seismology	1			N-N	N-N	N-N	N-N	N-N	N-N	N-N
	Economic geology	3			NN	NM	NM	N-N	N-N	N-N	N-M
Soils	Erosion hazard	5			M-M	M-M	M-M	M-M	M-M	M-M	M-M
	Rehabilitation potential[c]	5			M-M	M-M	M-S	M-H	M-H	M-S	M-S
Water Resources	Quality	5			S-S	S-N	S-S	S-S	S-S	S-S	S-S
	Demand	1			SS	SS	SS	SS	SS	SS	SS
Vegetation	Grazing (potential loss of forage)	4			S-M	S-M	M-S	M-S	S-M	M-M	M-M
	Acres disturbed (permanent)	6			S-M	S-M	M-S	M-S	S-M	S-M	S-M
	Acres disturbed (temporary)	6			S-M	S-M	M-S	M-S	S-M	S-M	S-M
Wildlife	Terrestrial	9			S-M	S-M	S-H	M-S	M-H	M-H	S-H
	Aquatic	2			S-S	N-N	N-N	N-N	N-N	N-N	N-N
Ecological Interrelationships	Terrestrial	9			S-M	S-M	S-H	M-S	M-H	M-H	S-H
	Aquatic	2			N-N	N-N	N-N	N-N	N-N	N-N	N-N
Paleontology		3			S-M	S-M	S-M	M-S	S-S	M-H	M-H
Archaeology		8			M-M	M-H	M-M	M-M	M-H	M-H	M-H
History		5			M-H	M-H	M-H	S-S	M-H	M-H	M-H
Recreation	General	3			S-S	S-S	M-H	M-M	M-H	M-H	M-H
	Scenic values	6			M-H	M-H	H-M	M-M	S-H	M-H	M-H
	Natural values	6			M-H	M-M	H-M	M-M	S-H	M-H	M-H
Land Uses	Miles of new corridor (more or less than prop.)	10	Same as John Henry Alternate of the Kaiparowits-Phoenix Route	Same as John Henry Alternate of the Kaiparowits-Phoenix Route	+24	-7	-22	+54	+70	+131	154
	Wood Products	1			S-S	S-S	S-N	S-S	S-S	S-S	S-N
	Agriculture	1			N-N	N-N	N-N	N-N	N-N	N-N	N-N
Socio-Economic	Housing and services	1			M-M	M-M	M-M	M-M	M-N	M-N	M-N
	Culture and attitudes	5			M-H	M-M	M-M	M-S	M-H	M-H	M-H

[a]Impacts rated as N-none; S-slight; M-medium; H-high - All alternates are compared to that part of the proposed replaced by the alternate. The first letter indicates the impact each resource would undergo along the replaced segment of the proposed route. The second letter indicates the impact each resource would undergo along the alternate where it deviates from the proposed route.

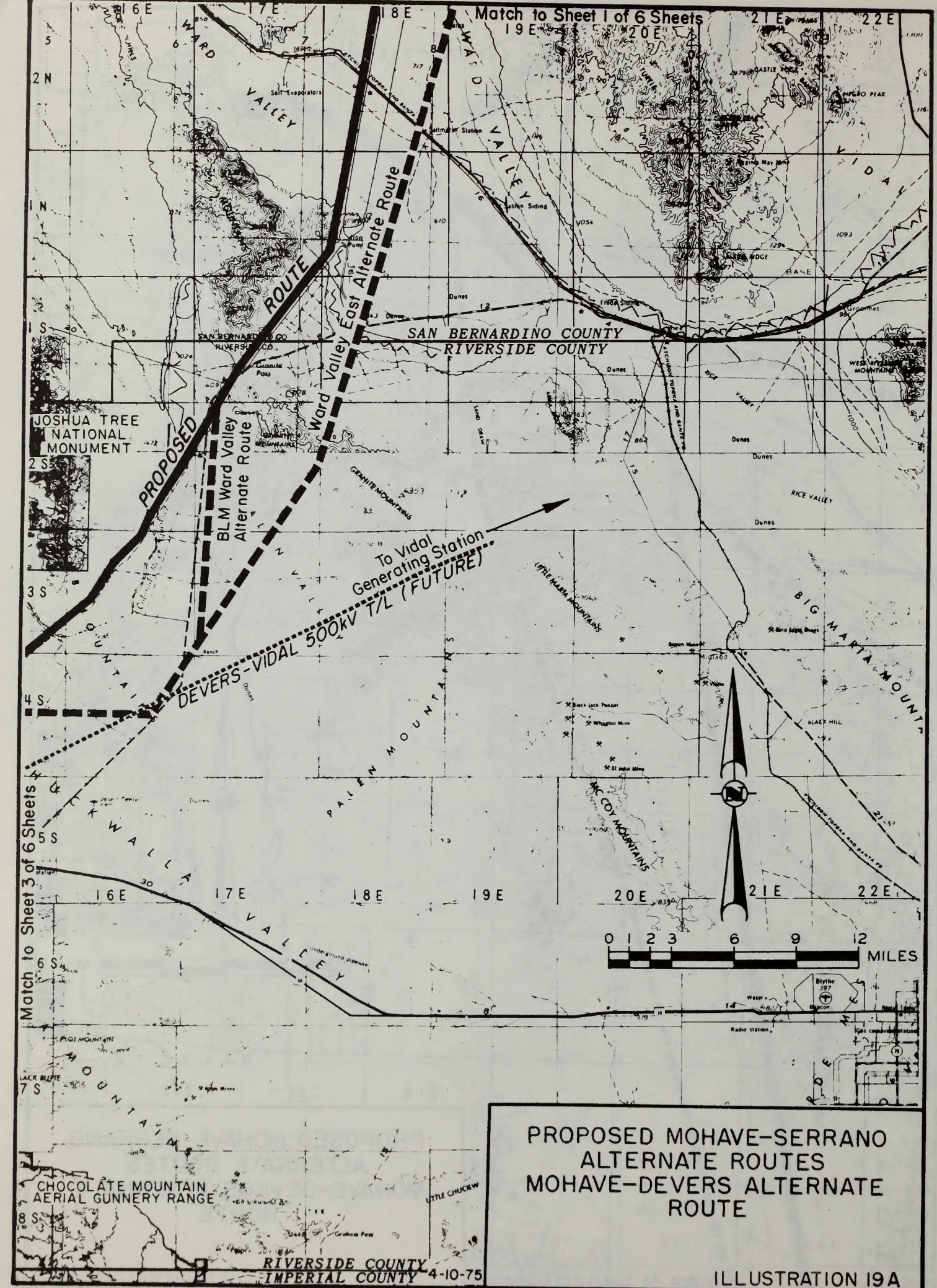
[b]Rated from 1 to 10 - This rating indicates the significance of each resource to decision making. Generally, ratings are based either on the degree to which a resource or activity would be impacted, or on the degree of potential controversy surrounding the resource or activity; the higher the rating, the higher the potential for impacts or controversy.

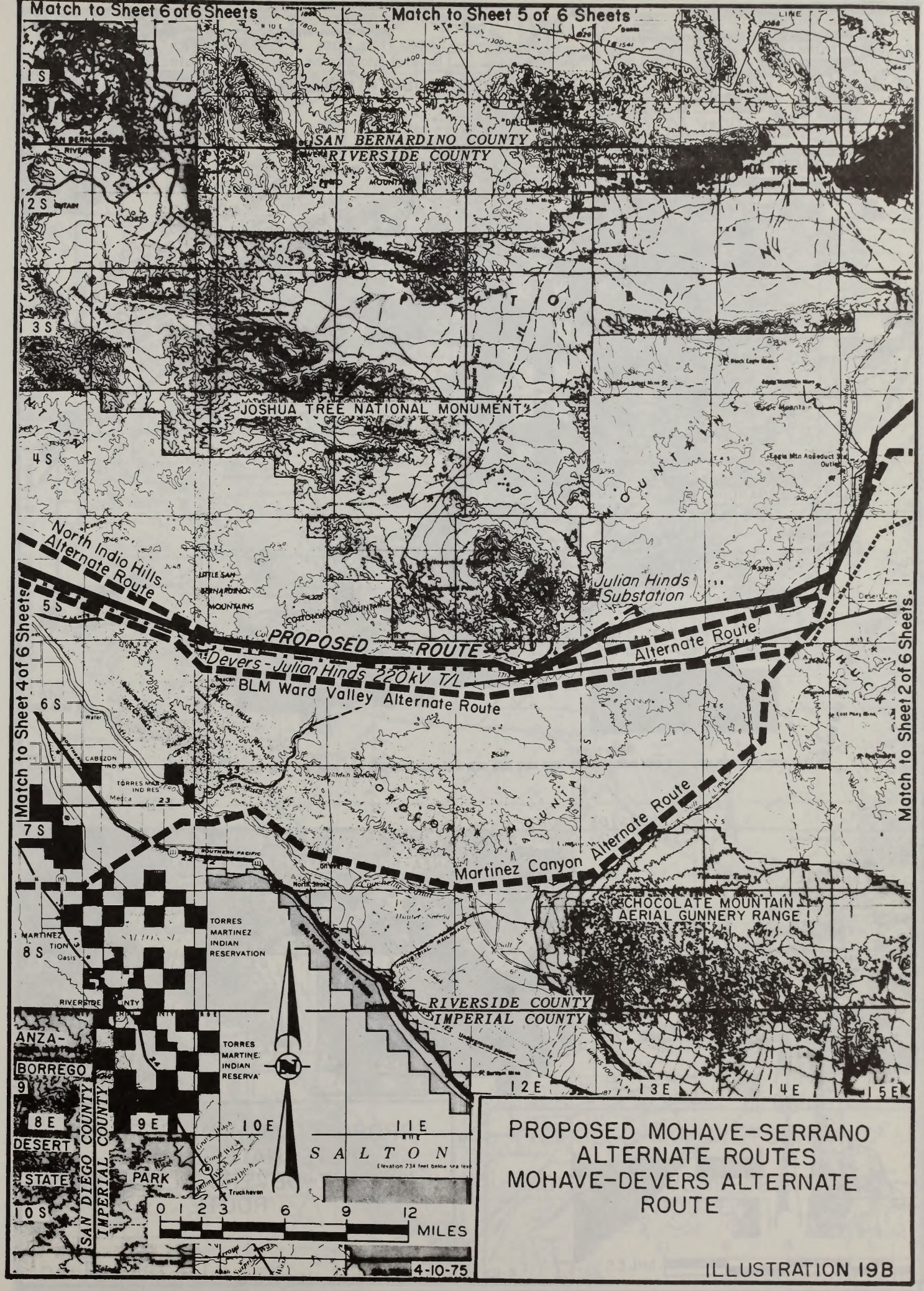
[c]This rating is not a comparison of impacts, but instead is a comparison of rehabilitation potentials.



PROPOSED MOHAVE-SERRANO ALTERNATE ROUTES MOHAVE-DEVERS ALTERNATE ROUTE

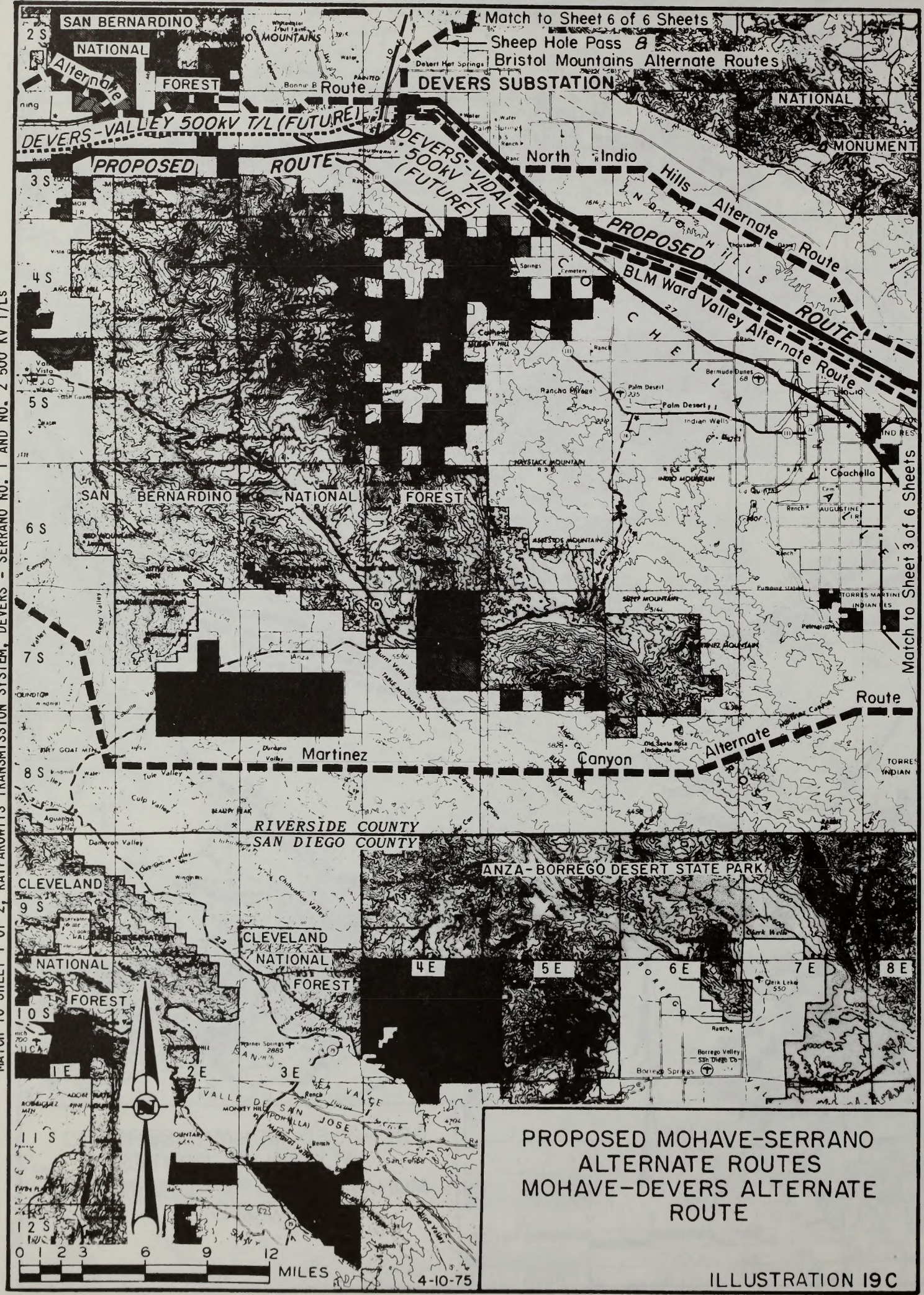
ILLUSTRATION 19


Match to Sheet I of 6 Sheets
Match to Sheet 3 of 6 Sheets
PROPOSED MOHAVE-SERRANO ALTERNATE ROUTES
MOHAVE-DEVERS ALTERNATE ROUTE
ILLUSTRATION 19A
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
JOSHUA TREE NATIONAL MONUMENT
PROPOSED MOHAVE-SERRANO ROUTE
BLM Ward Valley Alternate Route
Ward Valley East Alternate Route
To Vidal Generating Station
DEVERS-VIDAL 500kV T/L (FUTURE)
CHOCOLATE MOUNTAIN AERIAL GUNNERY RANGE
RIVERSIDE COUNTY
IMPERIAL COUNTY
4-10-75
MILES
0 1 2 3 6 9 12
16E
17E
18E
19E
20E
21E
22E
1N
1S
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4S
5S
6S
7S
8S
2N



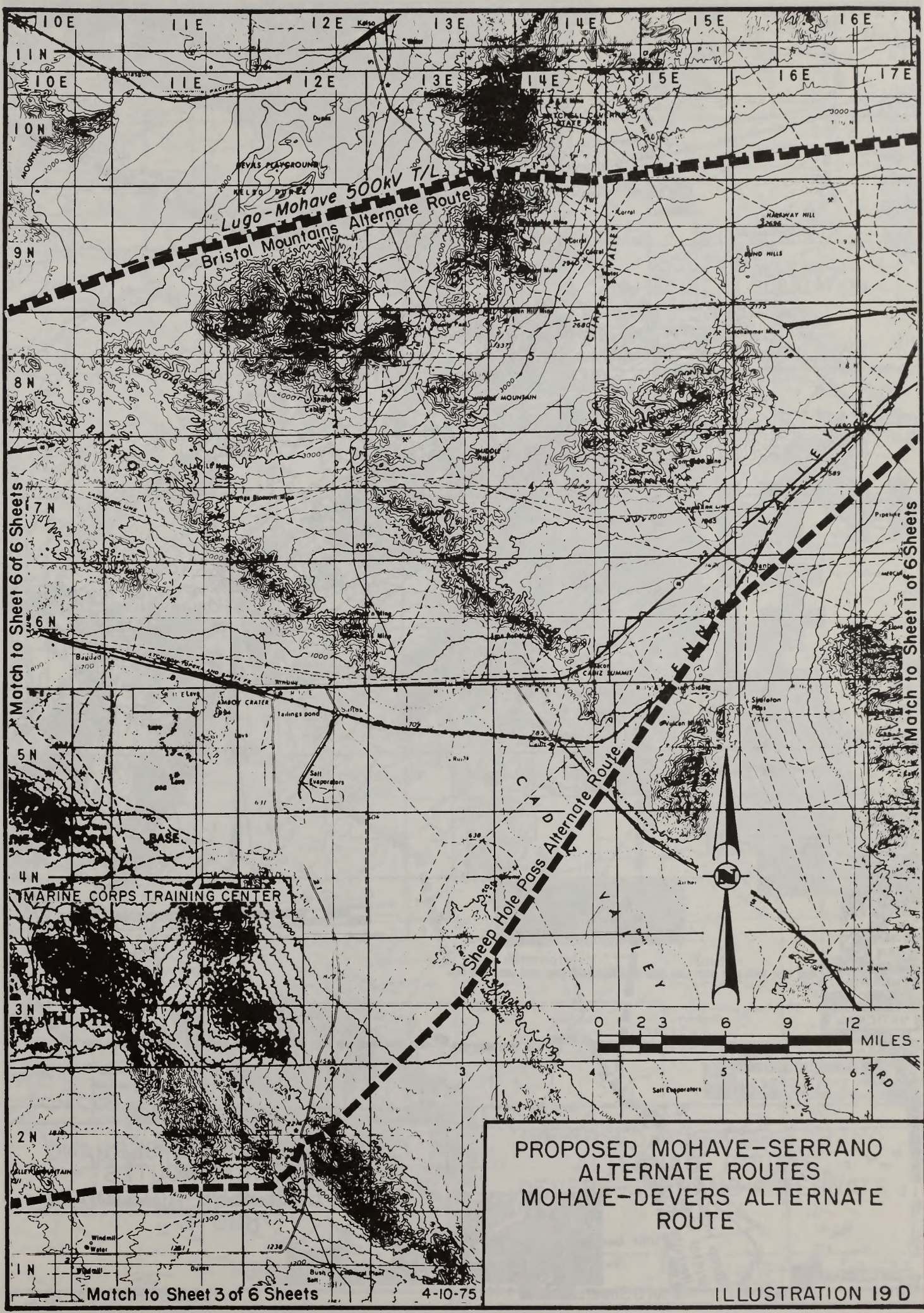
PROPOSED MOHAVE-SERRANO ALTERNATE ROUTES
MOHAVE-DEVERS ALTERNATE ROUTE

ILLUSTRATION 19B



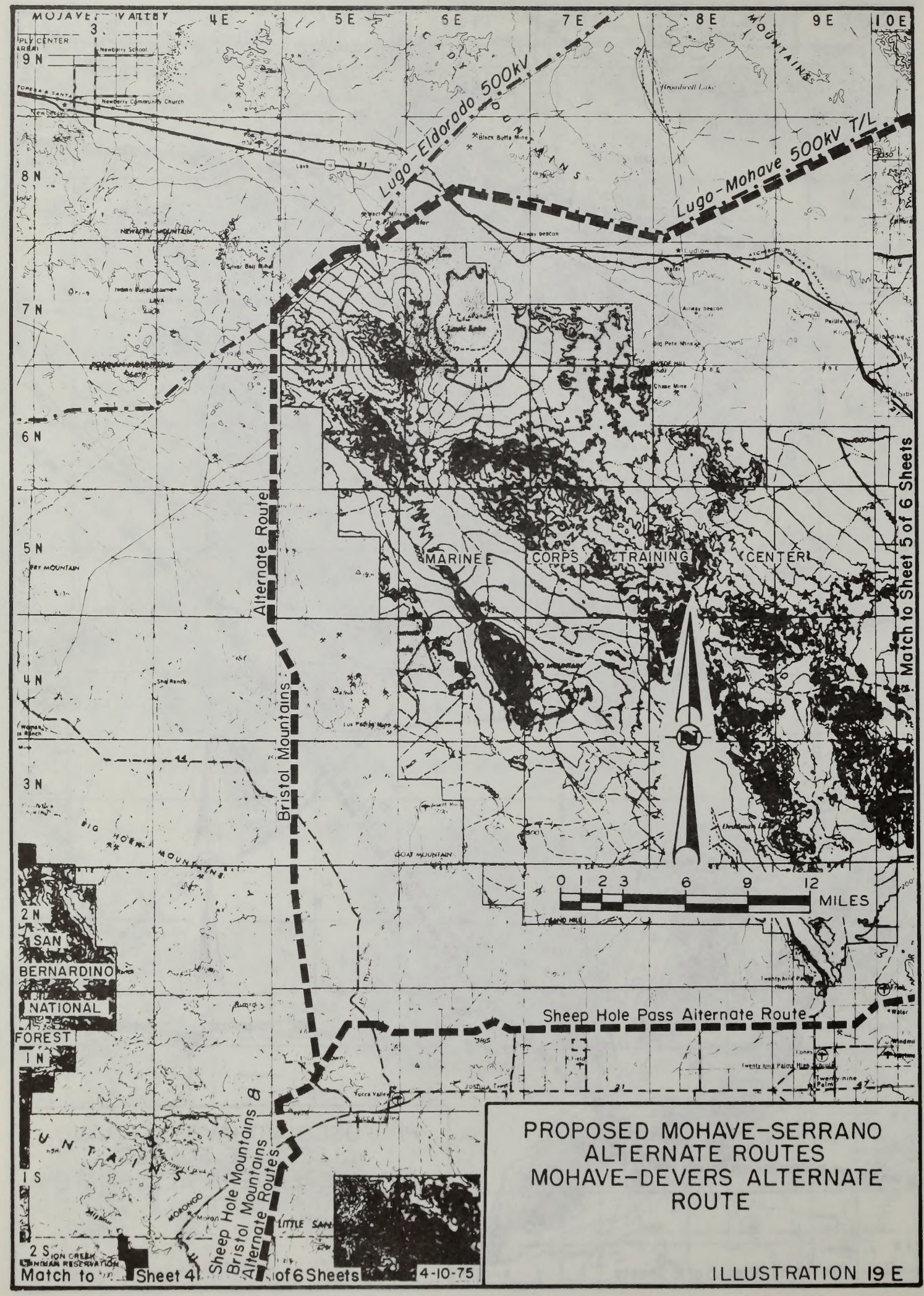
PROPOSED MOHAVE-SERRANO ALTERNATE ROUTES
MOHAVE-DEVERS ALTERNATE ROUTE

ILLUSTRATION 19C



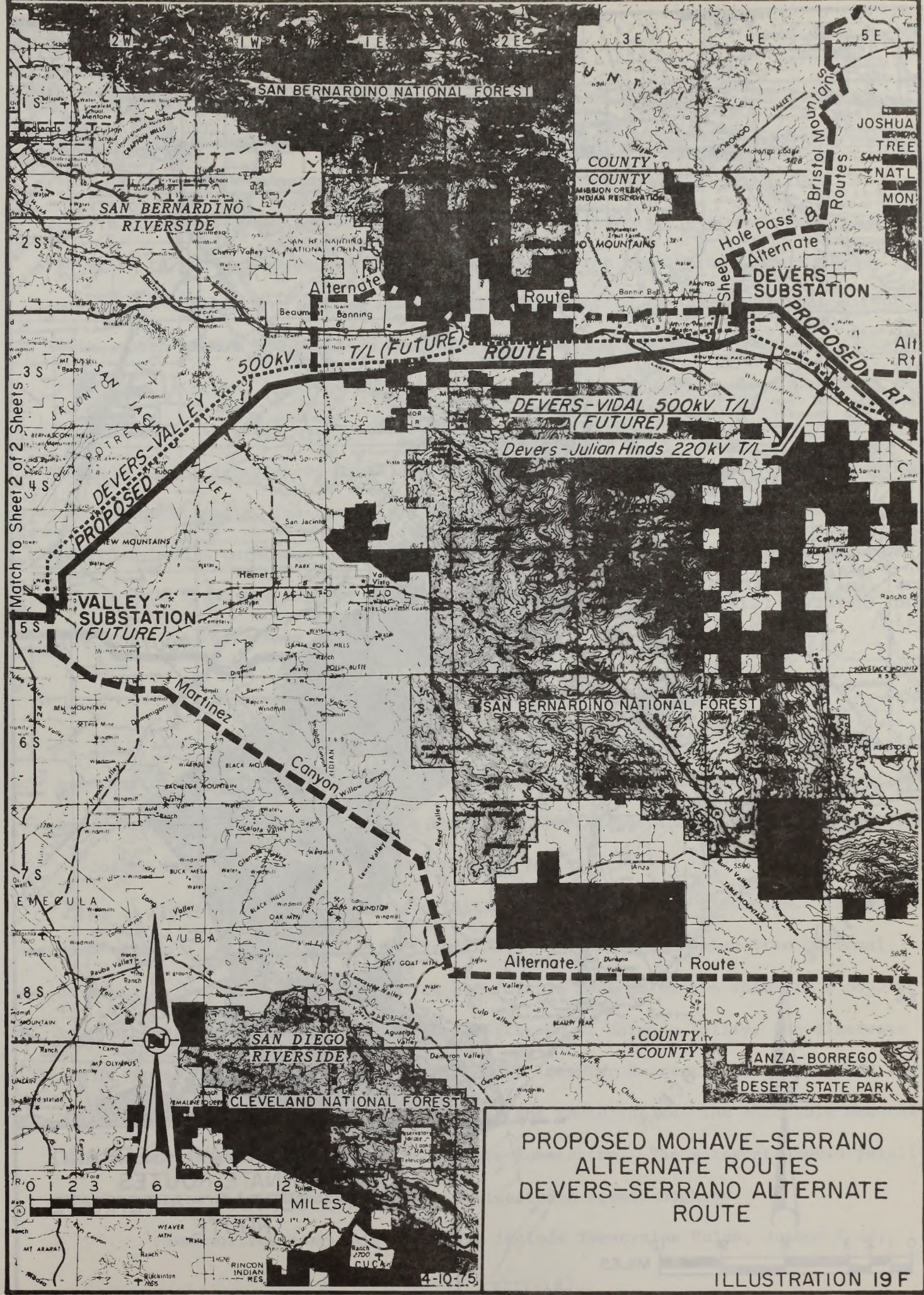
PROPOSED MOHAVE-SERRANO ALTERNATE ROUTES
MOHAVE-DEVERS ALTERNATE ROUTE

ILLUSTRATION 19 D



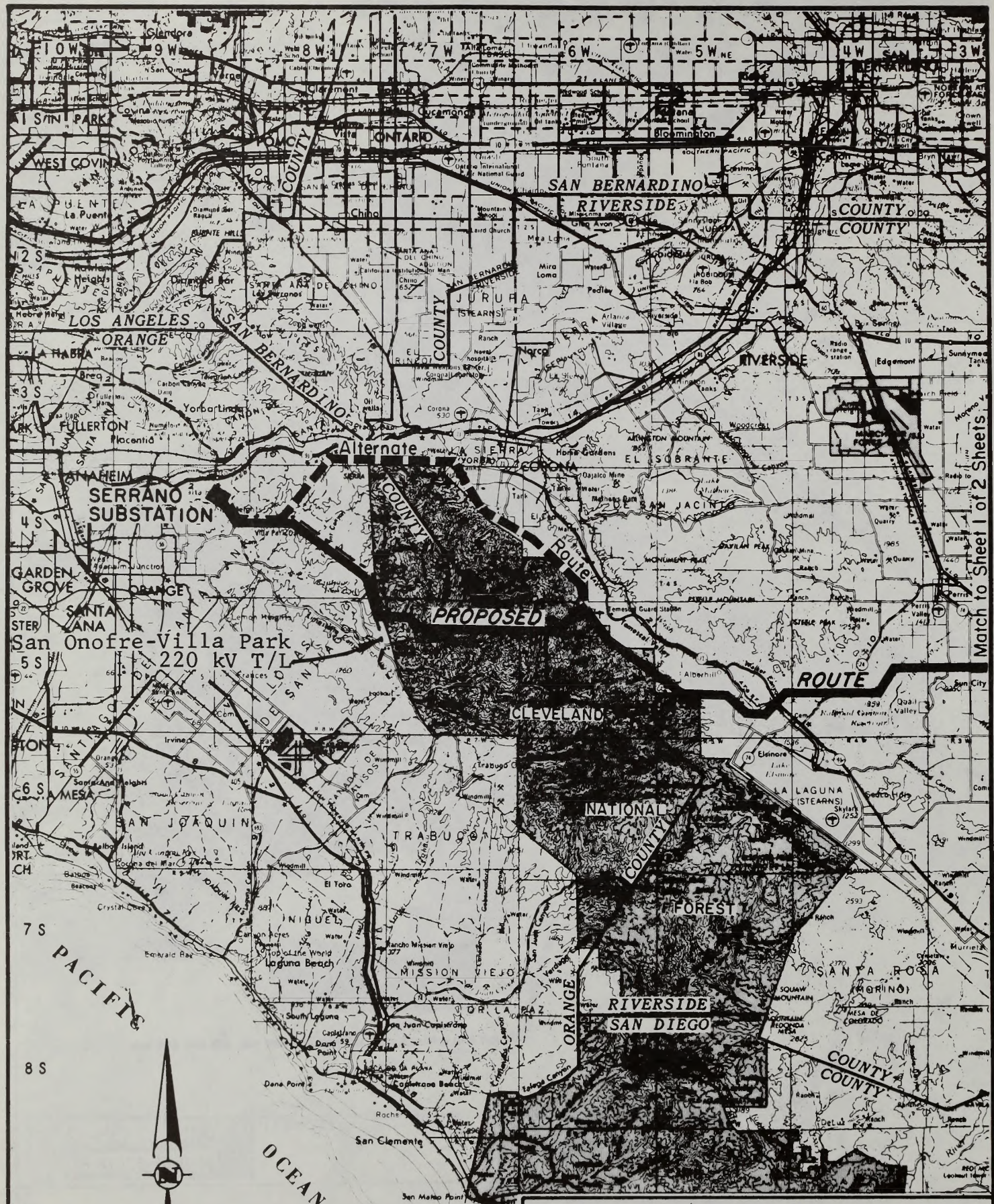
PROPOSED MOHAVE-SERRANO ALTERNATE ROUTES MOHAVE-DEVERS ALTERNATE ROUTE

ILLUSTRATION 19 E



PROPOSED MOHAVE–SERRANO ALTERNATE ROUTES
DEVERS–SERRANO ALTERNATE ROUTE

ILLUSTRATION 19 F



PROPOSED MOHAVE-SERRANO
ALTERNATE ROUTES
DEVERS-SERRANO ALTERNATE
ROUTE

ILLUSTRATION 19 G

and go through Sheephole Pass southwest of the Bullion Mountains. The alternate would then turn west passing three miles north of the Amboy Road to Valley Mountain. This section of the route would be north of Twentynine Palms.

From Twentynine Palms the alternate would continue west for about 22 miles, parallel to and approximately three miles north of the Twentynine Palms Highway, passing to the north of Joshua Tree National Monument to an angle point about four miles north of the Yucca Valley community. The alternate would then turn southwest for about 13 miles, crossing Pioneertown Road and passing within about a mile of Pioneertown. It would then cross Twentynine Palms Highway at the northern end of Morongo Valley and proceed south along the east side of the valley. After crossing the northwest end of the Little San Bernardino Mountains and Big Morongo Wash, the alternate would turn west and cross Twentynine Palms Highway. The alternate would turn south, cross the highway again, and rejoin the proposed route at Devers Substation. This alternate would be 235 miles long.

Description of the environment

The Sheephole Pass alternate route passes through the same vegetative association as the proposed route. In addition, the alternate would cross about five miles of pinyon-juniper woodland in the Little San Bernardino Mountains and 15 miles of Joshua tree woodland in Yucca and Morongo Valleys.

Recreational resources are quite diverse along this alternate. It would pass within a few miles of the north and west boundaries of Joshua Tree National Monument. The alternate would travel down Little Morongo Canyon which is a popular birdwatching and hiking area. Near the north end of Morongo Valley, the alternate would cross the southeast corner of Bighorn-Whitewater Recreation Lands. Other areas with general scenic or natural values along the route include the Sheephole Mountains and the area between Pioneertown and Devers Substation. The alternate would parallel the Twentynine Palms Highway which is designated a scenic highway.

Communities near this alternate include Twentynine Palms, Joshua Tree,

Yucca Valley, Pioneertown, Morongo Valley, Desert Hot Springs, and North Palm Springs. San Bernardino County's plans call for resource reserves and preservation of natural resources except in the area from Twentynine Palms to Morongo Valley. This area is called a rural retreat area with numerous weekend or second homes. Proposals to route transmission line rights-of-way through this area have been defeated in the past because of strong public sentiment against them.

Scattered sections of this alternate were spot-checked for archaeological values. Near the Pisgah Lava Beds, it would cross an area of desert pavement and sandy soils where chert cores and waste flakes have been found. This area, is characterized by at least 20 dense concentrations (one to four meters in diameter) of these cultural remains. Such concentrations apparently represent lithic tool workshops. Another recorded site located north of Twentynine Palms appears to have been a large occupation site; materials noted on the present surface include potsherds, flakes, and milling tool fragments.

Environmental impacts of alternate action

About four acres of pinyon-juniper woodland and eleven acres of Joshua tree woodland would be permanently disturbed along this alternate. Although it would result in about 24 fewer acres of permanently disturbed soil and vegetation than the proposed route, the alternate would create 125 miles of new corridor in the California desert. This improvement of access could eventually result in further loss of vegetation and archaeological values as off-road vehicle use increased.

Although the alternate could reduce scenic and natural qualities of several areas, the impacts would be similar to the proposed route. There would probably be strong public sentiment against routing a transmission line from Twentynine Palms to Morongo Valley. In addition, the alternate would conflict with San Bernardino County land use plans. The alternate would be visible from developed areas and it could result in reduced land values nearby.

Mitigating measures

Same as proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

Loss of about four acres of pinyon-juniper woodland in the Little San Bernardino Mountains and 11 acres of Joshua tree woodland in Morongo Valley would be unavoidable. Although the alternate would result in 24 fewer acres of permanently disturbed land than the proposed route, the alternate could eventually result in greater losses because it would improve access to the California desert. The alternate would conflict with San Bernardino County land use plans from Twentynine Palms through Morongo Valley and it would conflict with public attitudes in the Twentynine Palms area.

Bristol Mountains alternate

Description of alternate action

This alternate would follow the proposed route for about 12 miles from the Mohave Generating Station and then continue southwest parallel to and 2,000 feet south of the Lugo-Mohave 500 kv line. It would cross Piute Valley to an angle point located about one half mile north of Fenner Hill, and then angle west for about 23 miles, to the western slope of the Providence Mountains. The alternate would pass about one mile south of Mitchell Caverns State Park in these mountains and then bend southwest for about 37 miles. Along this segment, the alternate would skirt Kelso Dunes and cross Bristol Mountains. About one mile northwest of Ludlow, it would turn northwest for ten miles along the southern end of Cady Mountains.

The alternate would again turn southwest about one-half mile north of Pisgah and cross the Atchison, Topeka and Santa Fe Railroad tracks and Interstate 10. The alternate would follow the northwest boundary of the Twentynine Palms Marine Corps Training Center for about seven miles. It would then turn south leaving the existing lines and parallel the training center boundary for four miles. The alternate

would continue south between Bullion Mountains on the east and Lucerne Valley and Bighorn Mountains on the west. After 34 miles it would meet and follow the Sheephole Pass alternate. This alternate would be 253 miles long.

Description of the environment

Vegetation along this alternate is similar to the proposed route. Exceptions are pinyon-juniper woodland in the Providence Mountains and pinyon-juniper and Joshua tree woodlands described for the Sheephole Pass alternate.

Parts of the route were surveyed for archaeological sites, but none were found. However, the alternate is believed to have approximately the same potential for such values as the proposed route.

Scenic, natural, and recreation values along this alternate are similar to the proposed route and the same as part of the Sheephole Pass alternate. In addition, the Bristol Mountains alternate would cross near Mitchell Canyons State Park in the Providence Mountains and the Kelso Dunes area which is closed to off-road vehicle use. The alternate would also cross highways I-40 and S.R. 247, which are classified as scenic highways in the California State Master Plan.

For land use planning, the discussion of the Sheephole Pass alternate applies to this alternate. In addition, San Bernardino County's General Plan identifies three areas along this alternate as Recreation-Conservation Areas. They are the Mitchell Caverns area, the area northwest of the Marine Corps Training Center, and the Bighorn Mountains. The alternate would not cross this last area. These areas are described as having large blocks of land, primarily in public ownership, where scenic, wildlife, and recreation values, and their potential for public enjoyment, are superior to other land in the desert portion of San Bernardino County.

Environmental impacts of alternate action

This alternate would result in impacts similar to those resulting from the proposed route. Although the alternate would create about 38 more miles of new

corridor than the proposed route, it would result in 11 fewer acres of disturbed soil and vegetation than the proposed route. Construction of the alternate through the Kelso Dunes area would result in improved access into an area closed to off-road vehicles. This could make it more difficult to prevent such use in the area. The alternate would also conflict with San Bernardino County land use plans in the Mitchell Caverns area and the area northwest of the Twentynine Palms Marine Base; however, the alternate would follow existing transmission lines on a 2,000 foot separation through both areas. Impacts on public attitudes discussed for the Sheephole Pass alternate also apply to the Bristol Mountains alternate.

Mitigating measures

After construction is complete, all access roads in the Kelso Dunes area would be obliterated. Maintenance of this segment of the route would be by helicopter only. This measure would insure that access into the Kelso Dunes area would not be permanently improved.

Any adverse effects which cannot be avoided should the alternate be implemented

This alternate could conflict with San Bernardino County land use plans and it could temporarily hamper enforcement of off-road vehicle restrictions in the Kelso Dunes area. Otherwise, impacts resulting from this alternate would be similar to those resulting from the proposed route and the Sheephole Pass alternate.

Ward Valley East alternate

Description of alternate action

This alternative would follow the proposed route for about 13 miles then depart south across the east side of Piute Valley to the Sacramento Mountains. It would continue south and southwest for 74 miles through the Sacramento Mountains, the east side of Ward Valley, the Danby Dry Lake area, the Granite Mountains, and Palen Valley. This portion of the alternate would cross U.S. Highways 95 and 66, the Santa

Fe Railroad main line to Needles, the Four Corners Pipeline right-of-way, the Southern California Gas Company Pipeline right-of-way, the Santa Fe Railroad Parker Dam Spur Track right-of-way near Danby Dry Lake, and the Colorado River Aqueduct near Iron Mountain.

The alternate would turn west near the southern tip of the Coxcomb Mountains and cross Chuckwalla Valley for seven miles. It would then turn to the southwest and proceed for about 13 miles and rejoin the proposed route near the Eagle Mountain Aqueduct Station. This alternate would be about 270 miles long.

Description of the environment

This alternative would more or less parallel the proposed route at a distance of up to nine miles. Therefore, the environment along the alternate is similar to the proposed route with few exceptions. The alternate would pass through a proposed natural area in the Sacramento Mountains with a unique stand of Bigelow cholla. This area is closed to off-road vehicles. The alternate would also pass within one and one-half miles of a small airstrip at Iron Mountain Pumping Plant.

Environmental impacts of alternate action

This alternate would reduce scenic and natural qualities of a proposed natural area in the Sacramento Mountains. The alternate would be far enough away from the Iron Mountain Pumping Station that it would have no effect on use of the airstrip. Although the alternate and proposed routes would be nearly the same length, the alternate would create 99 more miles of new corridor than the proposed route.

Mitigating measures

Upon completion of construction, all access roads in the Sacramento Mountains proposed natural area would be obliterated. This would help maintain the remaining natural values after construction of the line.

Any adverse effects which cannot be avoided should the alternate be implemented

The alternate would result in loss of natural and scenic values in part of the Sacramento Mountains. Even if access roads were obliterated, the alternate could render this area unsuitable as a natural area. The alternate would create 99 more miles of new corridor than the proposed route.

Martinez Canyon alternate

Description of alternate action

The alternate route would follow the proposed route to where the proposed route would turn west along the south boundary of Joshua Tree National Monument. The alternate would continue southwest to the northwest end of the Chuckwalla Mountains and then proceed south and southwest roughly parallel to the Eagle Mountain Railroad and pass through the Salt Creek Area. It would continue southwest and west around the south side of the Orocopia Mountains, parallel with and north of the Coachella Canal.

The alternate would then turn and proceed toward the southwest, cross the canal, angle west for approximately two miles, and then turn southwest, crossing State Highway 111. It would turn west into a portion of the Torres Martinez Indian Reservation, cross both Highways 195 and 86 and continue through Martinez Canyon. The alternate would then proceed southwest through Santa Rosa Mountains, then west, parallel with and three miles north of the Riverside-San Diego County line, through Nicholias Canyon and Alder Canyon. It would continue west traversing Horse, Nance and Tule canyons, and then cross Terwilliger Canyon to enter the southern portion of Durasna Valley. Continuing west, the alternate would pass through Rogers Canyon and cross Tule Valley to the "Dry Ranch" area. Angling north it would cross State Highway 71 and enter Wilson Valley. The alternate would continue north through Wilson Valley and northwest to Weber Valley and Tucalota Creek. Continuing northwest, it would cross Highway 79 and Crown Valley, and then on to Domenigoni Valley, southeast

of Winchester. The alternate line would then angle west to north through various angle points and rejoin the proposed route at Valley Substation. This alternate would be approximately 273 miles long.

Description of the environment

The large concentration of archaeological sites is found in Martinez Canyon. This canyon is reported to be the ancestral home of a clan of the Desert Cahuilla. In addition, a known ethnographic village is located in the canyon. Thirty-four archaeological sites have been recorded in the canyon environs. Included were three midden village sites with dense artifact scatters, structure rings, and bedrock milling stones, 20 temporary occupation camps with little or no midden development and fewer artifacts, seven bedrock milling sites, one historic Indian-American camp, one rockshelter, one agave roasting pit, and two trail segments. An archaeological survey has not been completed from Martinez Canyon to Valley Substation.

The route would proceed through the "Salt Creek" area lying between the Orocopia Mountains to the west, the Chuckwalla Mountains to the east, and the Chocolate Mountains to the south. This area contains numerous archaeological sites. Significance and interpretive potential have not been determined. The Santa Ana range also contains numerous archaeological sites and evidence of historic Indian habitation. The alternate route would pass to the south of the Orocopia Mountains and the Mecca Hills, each described in the proposed route narrative.

Portions of the alternate would cross scenic areas in Alder, Horse, Nance and Tule canyons presently under application by California State Parks for incorporation into Anza Borrego State Park. These lands are classified by BLM as suitable for recreation and public purposes. The route would pass through the Santa Rosa Mountains. This is a proposed natural area high in primitive, scenic and wildlife values, most notably bighorn sheep. The alternate would also cross a proposed natural area near Salt Creek.

The alternate route would cross Highways 195 and 86, neither of which would

be crossed by the proposed route. Both highways appear in the California Master Plan for scenic highway designation. Highway 86 has an approximate average daily traffic (ADT) of 2,100 vehicles.

Land use is somewhat diverse along this alternate. The alternate would cross agricultural lands in Coachella Valley and scattered parcels from Terwilliger Valley northwest to the Valley Substation. Many of these lands produce grapes and citrus crops. The alternate would cross within several miles of North Shores Airport at the north end of Salton Sea, Thermal Airport, and two private airstrips in Durasno Valley. Areas of residential development along the alternate would include Coachella Valley, the Anza Terwilliger Area and scattered areas east of Valley Substation. Part of Torres Martinez Indian Reservation in Coachella Valley would be crossed by this alternate.

Environmental impacts of alternate action

Of all the Mohave to Serrano transmission routes suggested, both proposed and alternates, this route would appear to have the greatest potential impact on archaeological sites, especially in Martinez Canyon and Salt Creek areas. There seems little doubt that an additional 77 miles of construction activities associated with this corridor would alter or destroy many irreplaceable sites, ruin the integrity of an archaeological locality, and prevent reconstruction of a region's prehistory.

The proposed line would reduce scenic and natural values of proposed natural areas in the Santa Rosa Mountains and near Salt Creek. Bighorn sheep in the Santa Rosa Mountains could be forced to move from part of their habitat because of improved access and subsequent harrassment. Passage of the proposed route through Alder, Horse, Nance and Tule canyon areas could reduce, if not completely nullify, the value of this area for inclusion in the California State Park System.

Mitigating measures

All construction from Martinez Canyon west to the Anza area would be

accomplished by helicopter only. No new access roads would be constructed in this area. This would help protect archaeological values along the route.

Any adverse effects which cannot be avoided should the alternate be implemented

Major differences in impacts between this alternate and the proposed route are potentially greater losses of archaeological and natural values along the alternate. The alternate would create about 77 more miles of new corridor than the proposed route. It is estimated that 25 percent of this new corridor would pass through areas with dense concentrations of archaeological sites. Although sites that occur along the alternate would be salvaged, irreplacable losses of data would be unavoidable. Loss of natural values would also be unavoidable in the Santa Rosa Mountains, Salt Creek Area, and areas being considered for inclusion in the California State Park system.

Devers to Serrano alternate

Description of alternate action

This alternate would begin at the southwest corner of Devers Substation and proceed west 13.8 miles to a point approximately 500 feet north of Interstate Highway 10 and 2.3 miles east of the city of Banning. This portion of the alternate would cross State Highway 62 just west of Devers Substation, the Whitewater River, a secondary road, the Colorado River Aqueduct, and three miles of Morongo Indian Reservation land north of Cabazon. This entire segment would be parallel to and 150 feet north of the Devers-Vista 220 KV transmission line located approximately one-half mile north of Interstate Highway 10.

From this point the alternate would turn to the northwest and proceed over gently sloping grasslands to an angle point near the junction of Mais Canyon and the San Gorgonio River. The alternate would continue to parallel the 220 kv transmission line corridor and cross an additional 2.5 miles of the Morongo Indian Reservation north of the city of Banning. The alternate route would then turn southwest, cross

the San Gorgonio River and Banning Canyon Road, and proceed 0.8 miles where it would turn west and continue to a point 0.3 miles east of Highland Springs Road. It would then turn directly south for 3.6 miles and rejoin the proposed route just east of the Beaumont-Potrero Road. The alternate route would cross two streets and Interstate Highway 10, 1.5 miles east of the city of Beaumont. From the intersection with the proposed route, this alternate would follow the proposed route alignment for 18 miles to Valley Substation.

Past Valley Substation the alternate route would continue to follow the proposed route for 23 miles until reaching a point on the west side of Temescal Valley. From this point it would depart from the proposed route and continue northwest for 9.3 miles across eastern foothills and canyons of the Santa Ana Mountains to the northeast corner of the Cleveland National Forest. The initial 3.2 miles of this segment would cross the National Forest, while the remaining 6.1 miles would run just east of the Forest boundary. The cities of Corona and El Cerrito would be 1.5 miles northeast of the last portion of this segment. From the northwest corner of the Cleveland National Forest, the alternate route would turn west 3.5 miles through rugged mountainous terrain (elevation 2,200 feet) where it would cross the Southern California Edison San Onofre-Chino 220 kv transmission line. It would then proceed 1.7 miles through mountainous terrain to the east side of Gypsum Canyon just south of Riverside Freeway (Highway 91). From Gypsum Canyon the route would turn southwest 3.6 miles through mountainous terrain past Walnut Canyon Reservoir and Weir Canyon and rejoin the proposed route about two miles east of Serrano Substation. This alternate would be about 270 miles long.

Description of the environment

The first part of this alternate that deviates from the proposed route would cross an area of higher elevation. This route would not be as visible from I-10 as the proposed route and it would follow an existing 220 kv line at a 150 foot separation.

The alternate would pass through several more miles of the Morongo Indian Reservation and it would pass through Beaumont, California.

The second part of this alternate would skirt the Santa Ana Mountains and pass through three miles of Cleveland National Forest. The proposed route would cross through nine miles of the forest, part of which is a roadless area designated by the Forest Service. The alternate would pass within two miles of the cities of Corona and El Cerrito.

Environmental impacts of alternate action

Most impacts resulting from this alternate would be the same as those resulting from the proposed route. The alternate would create less surface disturbance than the proposed route because it would follow existing lines on a 150 foot separation for 56 more miles than the proposed route.

The alternate would result in higher visual impacts because it would pass through the outskirts of Beaumont, near Banning, and within two miles of Corona and El Cerrito. The proposed route would miss Banning and Beaumont by three miles and Corona and El Cerrito by six miles. The alternate could reduce property values and limit residential development in these areas. The alternate would reduce scenic values around the north end of the Santa Ana Mountains. The alternate would completely avoid a designated roadless area in the Cleveland National Forest.

Mitigating measures

Same as proposed route.

Any adverse effects which cannot be avoided should the alternate be implemented

Since the alternate would pass through or near the Banning-Beaumont and El Cerrito-Corona areas it could reduce property values and limit residential development in these areas. The proposed route would have less effect on these areas because it would miss both areas by several miles. However, the alternate would follow existing

lines through the Banning-Beaumont area. In addition, it would create 56 fewer miles of new corridor than the proposed route.

BLM Ward Valley alternate

Description of alternate action

This alternate would follow the proposed route for 11 miles. Rather than following the proposed route to the southwest, it would continue along the Bristol Mountains alternate for 11 miles to the MWD 220 kv transmission line. After crossing this line, the alternate would turn south and parallel it, rejoining the proposed route about 2 miles south of the Santa Fe Railroad.

After crossing the highway to Desert Center just west of the Granite Mountains, the alternate route would again leave the proposed route and proceed along the east side of the highway. It would follow this route for 11 miles to the Ward Valley East alternate and follow the alternate to the proposed route.

The alternate would continue along the proposed route and then follow the Martinez Canyon alternate for almost four miles. After crossing Interstate 10, the alternate would turn west parallel to and up to one mile south of the highway. The alternate would follow the highway for 29 miles and then turn northwest for two miles and cross Highway 10. After crossing Highway 10, the alternate would follow the south side of the Devers-Julian Hinds transmission line to Devers Substation rather than the north side as the proposed route would. This alternate would be 276 miles long.

Description of the environment

With few exceptions the environment along this alternate is similar to the proposed route. However, the alternate would not cross the Coxcomb Mountains, which is a scenic area. By remaining south of I-10 for 29 miles the alternate would avoid scenic areas along the south boundary of Joshua Tree National Monument. The alternate would also avoid an area of springs and scenic values in the Indio Hills

because it would stay south of the Devers-Julian Hinds transmission line. The proposed route would be north of this existing line.

Environmental impacts of alternate action

Although it would be nine miles longer and create 22 more miles of new corridor than the proposed route, this alternate would have less impact on scenic areas. The alternate would avoid Coxcomb Mountains, the area adjacent to Joshua Tree National Monument, and Indio Hills. In addition, the alternate would avoid possible disturbance of springs in Indio Hills because it would be south of the existing line while the proposed route would be north of the line. Desert wildlife use these springs, and disturbance resulting from construction and improved access could force wildlife to seek other sources of water.

Mitigating measures

Same as proposed route

Any adverse effects which cannot be avoided should the alternate be implemented

Unavoidable adverse impacts along the alternate route would be similar to the proposed route, except the alternate would avoid areas of high scenic quality in Coxcomb Mountains, along Joshua Tree National Monument, and Indio Hills. Although the alternate would create about 22 miles of new corridor north of Desert Center, it would avoid Coxcomb Mountains. Surface disturbance along either the alternate or proposed route would be nearly the same. The alternate would avoid the possibility of preventing wildlife from using the springs in Indio Hills.

North Indio Hills alternate

Description of alternate action

This alternate would follow the proposed route from Mohave Generating Station for about 147 miles to a point about three miles north of Mecca Hills. From Chiriaco Summit area, the alternate route would cross existing SCE Company's Devers -

Hayfield (Julian Hinds) 220 kv line. From the crossing, the route would parallel the 220 kv line for 15 miles, skirting the southern boundary of the Joshua Tree National Monument within the corridor established by the Devers - Hayfield (Julian Hinds) transmission line, Colorado River Aqueduct and Southern California Gas Company's pipeline rights of way. All these facilities are parallel with the proposed route.

The alternate route would then leave the proposed route in a northwestern direction and proceed around the southwest toe of the Little San Bernardino Mountains for 11 miles. Continuing northwest, the route would then cross Dillon Road, proceed to the northeastern toe of Indio Hills, follow the toe for 13 miles, and cross Thousand Palms Canyon Road. The alternate would then turn to the west and cross the northern extremities of Indio Hills and rejoin the proposed route.

Description of the environment

The existing environment along this proposed alternate is similar to the proposed route south of Indio Hills. However, the alternate passes near Thousand Palms County Park and crosses Thousand Palms Canyon which is an area of unique scenery in Indio Hills. The alternate would also cross or pass near areas of residential development north of Indio Hills.

Environmental impacts of alternate action

This alternate would generally result in impacts similar to those resulting from the proposed route south of Indio Hills. In addition, the alternate would reduce scenic qualities of the area around Thousand Palms County Park and Thousand Palms Canyon. The alternate could reduce residential land values along parts of the north side of the hills. The proposed route would not have as much effect on land values because it would avoid developed areas. Finally, the alternate would produce more overall scenic impact because it would create 34 more miles of new corridor than the proposed route.

Mitigating measures

Same as proposed route.

Any adverse effects which cannot be avoided should the proposal be implemented

Scenic impacts resulting from crossing Thousand Palms County Park and creation of 34 miles of new transmission line corridor could not be completely mitigated. Reduction of scenic quality near areas of residential development could result in decreased land values.

Impact evaluation

An impact evaluation of all proposed alternate transmission system routes for the Mohave to Serrano segment is contained in Figure 7.

Direct current and voltage levels

There are several alternative levels of voltages that could be used to transmit energy produced at the Kaiparowits Generating Station to the load centers using both AC (alternating current) and DC (direct current) circuits. The present technology considers that the following alternative AC or DC votage levels could also be used successfully.

Current	Voltage	Circuits	Lines
AC	345 kv	4 (3 phase)	4
DC	600 kv	1 Bipole	1
AC	765 kv	1 (3 phase)	1
DC	600 kv	2 Bipole	2

A comparison of each of the alternatives listed above, for critical information if any one is adopted, is shown in Figure 8. Each alternative is discussed below for its environmental impact.

FIGURE 7

Impact Evaluation of Alternate Routes for Proposed Mohave to Serrano Route[a]

		Importance to decision making[b]	Sheephole Pass	Bristol Mountains	Ward Valley East	Martinez Canyon	Devers Serrano	BLM Ward Valley	North Indio Hills
Mileage (more or less than proposed route)		5	-32	-14	+3	+6	+3	+9	+1
Climate		1	NN	NN	NN	NN	NN	NN	NN
Air Quality		3	SS	SS	SS	SS	SS	SS	SS
Geology and Topography	General	1	SS	SS	SS	SS	SS	SS	SS
	Seismology	2	MM	MM	SS	MM	MM	MM	MM
	Economic geology	1	NN	NN	NN	NN	NN	NN	NN
Soils	Erosion hazard	2	SS	SS	SS	MM	SS	SS	SS
	Rehabilitation potential[c]	1	SS	MM	SS	MM	SS	SS	SS
Water Resources	Quality	2	SS	SS	SS	SS	SS	SS	SS
	Demand	0	SS	SS	SS	SS	SS	SS	SS
Vegetation	Grazing (potential loss of forage)	1	SS	SS	NN	NN	NN	NN	NN
	Acres disturbed (permanent)	3	SS	SS	SS	SS	SS	SS	SS
	Acres disturbed (temporary)	3	SS	SS	SS	SS	SS	SS	SS
Wildlife	Terrestrial	4	MM	MM	MM	MM	MM	MM	MM
	Aquatic	1	NN	NN	NN	SN	SS	SS	SS
Ecological Interrelationships	Terrestrial	4	MM	MM	MM	MM	MM	MM	MM
	Aquatic	1	NN	NN	SN	SS	SS	SS	SS
Paleontology		2	NN	SS	SS	SS	SS	SS	SS
Archaeology		6	SS	SS	SS	SH	SS	SS	SS
History		3	SS	SS	SS	SS	SS	SS	SS
Recreation	General	8	MM	MM	MM	MH	MM	MM	MM
	Scenic values	10	MM	MH	MH	MH	SM	HM	SM
	Natural values	8	MM	MH	MH	MH	MS	MM	SS
Land Uses	Miles of new corridor (more or less than prop.)	8	+125	+38	+99	+77	-56	+12	+34
	Wood Products	0	NS	NS	NN	NN	NN	NN	NN
	Agriculture	2	SS	SS	SS	SS	SS	SS	SS
Socio-Economic	Housing and services	2	+MM	+MS	+M+M	+MS	+M+M	+M+M	+M+M
	Culture and attitudes	4	MH	MH	MM	MS	MH	MM	SM

[a]Impacts rated as N-none; S-slight; M-medium; H-high - All alternates are compared to that part of the proposed route replaced by the alternate. The first letter indicates the impact each resource would undergo along the replaced segment of the proposed route. The second letter indicates the impact each resource would undergo along the alternate where it deviates from the proposed route.

[b]Rated from 1 to 10 - This rating indicates the significance of each resource to decision making. Generally, ratings are based either on the degree to which a resource or activity would be impacted, or on the degree of potential controversy surrounding the resource or activity; the higher the rating, the higher the potential for impacts or controversy.

[c]This rating is not a comparison of impacts, but instead is a comparison of rehabilitation potentials.

FIGURE 8

Comparison of AC and DC Transmission Voltage Alternatives

Voltage Level	No. T/Ls	Average Tower Height	R-O-W Width	Conductors Bundles	Conductors No.	Routing
345 kv AC (4 circuits)		110 ft	330 ft	2 ft	24	Doubling up of proposed routes
600 kv DC (1 circuit) Bipolar	1	140 ft	200 ft	4	8	Kaiparowits to Moenkopi to Devers to Serrano
765 kv AC (1 circuit)	1	140 ft	250 ft	4	13	Kaiparowits to Moenkopi to Needles to Devers to Serrano
600 kv DC (2 circuits) Bipolar	2	140 ft	200 ft each	4	16	Same routes as proposal
765 kv AC (2 circuits)	2	140 ft	250 ft each	4	24	Same routes as proposal

345 kv AC (4 circuits)

This alternative would replace each proposed 500 kv transmission line with two 345 kv transmission lines. It would have six lines going south from the Kaiparowits plant to the Colorado River, crossing near Page, Arizona. From there two would go to the Navajo Generating Station and four would go on to the Moenkopi Substation. From there two would go to Phoenix and two would go to the Mohave Switchyard. From the Mohave Switchyard four lines would go to the Devers Substation and on to the Serrano Substation. The proposed Kaiparowits to Eldorado line would be replaced with twO 345 kv lines between those two points.

The environmental impacts are doubled for land area occupied, surface area disturbed, flora and fauna disturbed or destroyed, archaeological and cultural values disturbed, and aesthetic intrusion.

600 kv DC (one circuit)

This alternative could replace two 500 kv AC lines in the western system.

It would go from Kaiparowits past the Moenkopi substation, past the Mohave Switchyard, past the Devers Substation, and terminate at the Serrano Substation. Beneficial environmental impacts would be: could be undergrounded for reasonable distances, would have about one-half the impact on flora and fauna as proposal, and towers and conductors would be less massive and imposing on the view. This alternative would not have any major environmental disadvantages.

765 kv AC (one circuit)

This alternative would have the ability to carry all the energy for the western participants from plant to load center. It would go from the generating plant to Moenkopi Substation to Needles Substation to Devers and to Serrano. Beneficial environmental impacts would be: one-half of the disturbance to flora and fauna would occur, only one-half of the surface disturbance would occur, cultural and archeological impacts would be reduced by one-half, visual values would be preserved for the Kaiparowits to Eldorado segment.

Adverse environmental impact would be: the towers would be higher and more massive, creating a greater visual impact.

600 kv DC (two circuits)

This alternative could carry all of the energy produced at Kaiparowits Generating Station for the western system plus an additional 2,000 mw should Kaiparowits or any of the other proposed plants in Southern Utah be expanded above the proposed level. The transmission lines would occupy the same routes as the proposal for the 500 kv AC system. These lines would be efficient and could carry twice as much power as the proposal. Essentially, the impacts would be the same as the proposal.

765 kv AC (two circuits)

This alternative would have the capacity to transmit all of the western systems energy produced at the Kaiparowits Generating Station plus an additional

2,000 mw if that energy should become available at some time in the future. These lines would go along the same route as the proposed route. Beneficial environmental impacts would be the same as the double circuit 600 kv DC alternate. Environmental impacts of this alternative would be: more land needed for actual rights-of-way than by the participants proposals, and these towers and conductors would be more massive than those used in the proposal and would have a greater visual impact.

Use of existing transmission systems

Kaiparowits to Phoenix segment

Alternative #1

Description of alternate action

For the Kaiparowits to Phoenix segment, beginning near Navajo Power Plant, the existing Navajo twin 500 kv line on the alignment of the proposed action could be upgraded to one 765 kv and one 500 kv line left in place, or one of the existing 500 kv lines could be upgraded to double circuit 500 kv towers. This would have the effect of three 500 kv lines and one 330 foot right-of-way. Bureau of Reclamation engineers state that to upgrade the existing line for 765 kv conductor or to double circuit one line, the entire tower system including footings would have to be replaced. Also, if a 765 kv single circuit, self-supporting tower was used, an additional 30 to 50 feet of right-of-way would probably be needed. This is due to the greater mass of this type of tower. Estimates indicate that disassembly of the existing towers and reconstruction of new towers, whether single circuit 765 kv or double circuit 500 kv, would take twice as long as constructing one single circuit 500 kv line. Two hundred and fifty nine miles could be upgraded.

Description of the environment

The environment for this alternative would be the same as the proposed action for the Kaiparwotis to Phoenix route described in Chapter II.

Environmental impacts of alternate action

Soil disturbance by this operation would be severe. Most new disturbance would be confined to areas already disturbed from construction of existing lines. Since much of the original revegetation effort was unsuccessful, vegetation disturbance would be minimal and new construction would present an opportunity to do successful revegetation work.

Existing access roads could be used, closed, and revegetated. Impacts on wildlife populations would be minimal compared to having a second right-of-way, and undisturbed areas would not be opened for additional harrassment. One right-of-way would have less visual impact than having a second right-of-way in the same general area.

The greater mass of the 765 kv towers, both single and double circuit design requiring larger footings, more concrete, and more massive construction equipment would combine to create more visual impact and soil disturbance. All tower designs except vertical double circuit type would require a wider right-of-way. This would cause some new areas of soil and vegetation disturbance. A 765 kv vertical double-circuit tower would require a wider right-of-way and would be a minimum of 180 feet high. Because of its height, this tower would be seen from a greater distance. All 765 kv towers would cause greater visual impacts because of their mass. Systems reliability would be significantly reduced over that provided by two separate rights-of-way. Service to customers would be interrupted while construction was in progress - possibly for a year.

Mitigating measures

The same mitigating measures recommended for the proposed action in Chapter IV would be required for this alternative. Two additional mitigating measures would require all disassembled structural material be recycled and all foundation materials removed from existing towers would be disposed of in approved sanitary landfills.

Unavoidable adverse impacts

Essentially the same unavoidable adverse impacts would exist for this alternative as for the proposed Kaiparowits to Phoenix route. In addition, there would be increased soil compaction due to use of additional heavy equipment to remove the existing transmission system. Increased soil compaction would decrease the infiltration rate of soil and increase the rate and amount of runoff. The above effects to the soil would reduce the rehabilitation potential. There would be an estimated 11,600 cubic yards of concrete from the existing footings to dispose of in approved sanitary landfills.

Wildlife would be disturbed for a longer period of time because of the removal of existing transmission system and building the new larger system. About 1,250 acres more land would be committed to use because of additional right-of-way width needed for this alternate transmission system. Present service to Phoenix area consumers would be disrupted for up to one year, and system reliability would be decreased because one system would be transporting the energy instead of two systems.

Alternative #2

Description of alternate action

From Glen Canyon Dam to Pinnacle Peak Substation, the Bureau of Reclamation has two parallel 345 kv transmission lines with potential for upgrading. The 345 kv towers would be removed and replaced with twin 500 kv circuits -- one for this alternative and one for the Bureau of Reclamation needs. Since both lines would have to be removed, probably only one line would be inoperable at any one time. Construction time, as described in the proposed action, would increase four times. This alternative would result in the system carrying the present load plus the additional 500 kilovolts. The upgraded transmission line would be 164 miles long.

Description of the environment

A description of the environment is located in this chapter under the Pinnacle Peak Alternative.

Environmental impacts of alternate action

Estimated impacts for this alternate would be about 50 percent greater than those identified in Alternative #1 above. The additional impact would be caused by disassembly of two existing transmission lines and construction of two 500 kv transmission lines. Since this right-of-way is cleared, some impacts caused by construction would be minimized even though towers on both lines would be removed and twin 500 kv lines put in their place. This would cause much soil disturbance, but impacts on vegetation would be less. Existing roads could be used and disturbed areas revegetated. There would be an opportunity for reseeding areas that were not successfully revegetated after construction of the existing lines.

There would be an impact on wildlife during the construction phase. However, once construction is completed impacts on wildlife would be no greater than presently experienced. The 500 kv towers (both single circuit) have more mass than 345 kv towers and would create more visual impact. Systems reliability might be reduced for the Bureau of Reclamation system over that provided by the present twin 345 kv lines. There would also be the disruption of service while existing lines were being replaced.

Mitigating measures

The same measures suggested for Alternative #1 above would provide the maximum mitigation for this alternate.

Unavoidable adverse impacts

The unavoidable adverse effects for this alternative would be about 50 percent greater than Alternative #1, except both alternates would produce about the same visual impacts.

Kaiparowits to Eldorado segment

Alternative #3

Description of alternate action

Beginning at the intersection of the proposed route and existing Los Angeles

Department of Water and Power (Navajo to McCullough) transmission line at Cockscomb Ridge, there would be a possibility for upgrading existing single circuit towers to double circuit towers. Southern California Edison and LADWP could share a single right-of-way for a great distance since McCullough and Eldorado substations are only about one-fourth mile apart. Existing single circuit 500 kv towers would be completely removed and 500 kv double circuit towers erected in their place. This procedure is described in Alternative #1. About 237 miles of existing transmission line could be upgraded.

Description of the environment

A description of the environment along this alternative can be found in Chapter II under the discussion on the Kaiparowits to Eldorado segment.

Environmental impacts of alternative action

The impacts for this alternative would be similar to those discussed in Alternative #1. Both lines would have about 237 miles to upgrade. The most significant difference is that Alternative #3 would be more remote and not viewed from well-travelled roads as much as #1. In addition, it would not cross Indian reservations, thereby avoiding impact upon certain segments of Indian population who oppose transmission lines crossing their lands. For the remaining impacts see description of environmental impact in Alternative #1.

Mitigating measures

The same mitigating measures discussed for Alternative #1 would apply to this alternative.

Unavoidable adverse impacts

The unavoidable adverse impacts described in Alternative #1 would apply to this alternative also. The increased width would require an additional 1,150 acres of right-of-way. The lines would be less visible from hard-surfaced roads and there

would be no impact on Indian cultures.

Kaiparowits to Mohave segment

Alternative #4

Description of alternate action

This alternative would upgrade one of the existing APS 500 kv lines of the Navajo to Westwing system to double circuited 500 kv towers as far as the Moenkopi Substation. From there the existing APS 500 kv line from the Four Corners Power Plant to Eldorado would be upgraded to a double circuit 500 kv line until it joins the SCE 500 kv Mohave-Eldorado Intertie. The latter line could also be double circuited to Mohave Switchyard. Methods of disassembly and construction have been described in alternatives discussed above.

Description of the environment

The environment for this alternative has been described in the following sections of this statement. For the Kaiparowits to Moenkopi part, see description of environment for proposed Kaiparwotis to Phoenix route in Chapter II. The part from Moenkopi to Hualapai Indian Reservation is covered in the Chapter II discussion of Kaiparowits to Mohave segment. From Hualapai Indian Reservation to Mohave Power Plant the existing environment is discussed in the Eldorado Valley alternative in this chapter.

Environmental impacts of alternate action

Impacts created by upgrading segments of these 500 kv transmission lines would be about the same as described for proposed or alternative routes mentioned in the above paragraph. Greater impacts would occur for certain environmental components, such as: more severe soil disturbance caused by removal of existing tower footings and longer construction time necessitated by the disassembly period; longer periods of man's presence could be harmful to wildlife; the visual impact would be greater because of larger tower images; the wider right-of-way would require an additional

1,750 acres. There would be a decrease in system reliability, and cost would more than double. Consumers at load centers would be denied electric power while the existing line was removed and replaced by the larger line.

Mitigating measures

The same mitigating measures used for Alternative #1 would be adequate for this alternative.

Unavoidable adverse impacts

The unavoidable adverse impacts described for Alternative #1 would be repeated in the upgrading of these existing lines.

Mohave to Serrano segment

Potential for upgrading existing transmission lines for this segment would be poor. There are large gaps between existing transmission lines that follow the general direction of the Serrano Substation from the Mohave Power Plant. Therefore, upgrading this segment would not be a reasonable alternative.

Underground

Description of the alternate action

This alternative would bury proposed transmission lines below the surface. There could be an infinite number of possibilities if only partial burial of the conductors was considered.

There is a marked difference between undergrounding AC and DC systems. Technology for undergrounding AC systems is in an early stage. Presently only distances of one-fourth mile or less of 500 kv conductor can be undergrounded without intricate oil or inert gas pipe cooling systems. Extra high voltage DC transmission lines have been successfully undergrounded for up to 40 miles in other countries. While a 500 kv underground cable-pipe system may be technically feasible, costs could be ten times that of overhead transmission.

Description of the environment

The alternate action would have the same environment as the proposed action.

Environmental impacts of alternate action

The alternate action would disturb 3,500 acres more than the proposal. The effect of deep trenching and additional disturbance would make rehabilitation more difficult. The above effects would also increase the impact to wildlife. Pumping and cooling would require energy from some source, and this would impact our energy supply.

A beneficial impact would be preservation of the visual quality of scenic areas.

Mitigating measures

Mitigating measures for the alternate action would be the same as for those relating to visual impacts associated with towers and overhead transmission lines.

Unavoidable adverse impacts

More acres would be disturbed and rehabilitation would be more difficult. Also, energy would be consumed by operation of pumps and cooling systems. This alternate action would have more unavoidable impacts to natural resources than the proposed action but would lessen visual impact to areas traversed by the transmission system.

Line spacing

Description of alternate action

The alternate action would not allow 2,000 foot spacing in the three transmission system proposals. This alternate action would grant rights-of-way adjacent to and paralleling existing high voltage transmission lines along proposed routes.

Description of alternate action

The alternate action would not allow 2,000 foot spacing in the three transmission system proposals. This alternate action would grant rights-of-way adjacent to and paralleling existing high voltage transmission lines along proposed routes.

Description of the environment

The alternate action would have the same environment as the proposed action.

Environmental impacts of alternate action

The alternate action with a minimum line spacing would have the same impacts as the proposal, except the quantity of impacts would be reduced. There would be a reduction in total disturbed acres. The following information shows miles of 2,000 foot separation in each proposal and the possible reduction in disturbed acres.

	Miles of 2,000 foot separation	Possible Reduction in disturbed acres	Percent Possible Reduction
Primary Proposal	50	853	10
Northern Kaiparowits Preferred Alternate	538	915	11
Arizona strip Preferred Alternate	376	639	6

The reduced amount of disturbed acres would lessen the impact to vegetation, soil, wildlife habitat, aesthetics and visual intrusion. In addition, by decreasing the miles of new road built and placing transmission lines closer together there would be fewer areas opened to public access thus reducing possible damage to historical, cultural and archaeological values in the area. From a land management point of view, as observed by large land managers such as U.S. Forest Service, Bureau

of Land Management and the Navajo Tribe, the minimal spacing alternative is with good land stewardship practices.

Mitigating measures

The mitigating measures for the alternate action would be the same as for the proposal.

Unavoidable adverse impacts

The alternate action would reduce the adverse impacts because there would be fewer acres disturbed and less new access created. Reliability of the system might be reduced due to minimal spacing.

Limestone quarry

Alternate surface mining methods

The limestone could be extracted from the quarry by the use of: crawl-mounted tractors equipped with rippers, truck-mounted rotary/percussion drill, power shovels, and scrapers. Regardless of the alternative used impacts to the environment would not be any different than those discussed in Chapter III on the Limestone Quarry.

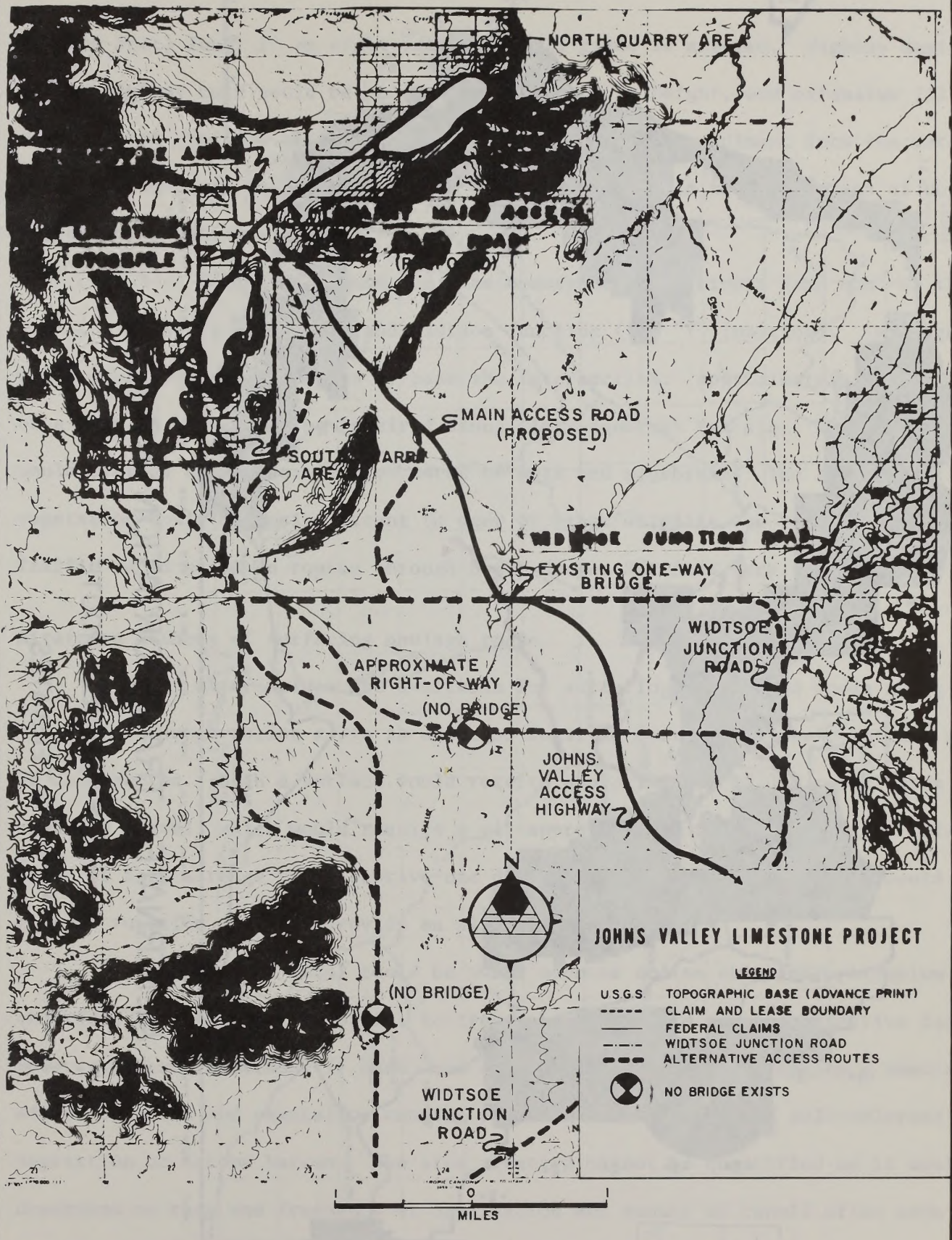
Alternate transportation routes and access roads

Several alternate access roads to quarry areas are possible. Exact routes would depend upon final design of quarry operation, easements, and environmental considerations. Those alternates which may disturb wildlife, specifically the endangered Utah prairie dog or sage grouse, would not be considered (see Illustration 20).

Various alternate highway haulage routes and variations of the proposed route are available (see Illustration 21). Considerations concerning these alternatives include the following:

1. An alternate highway routing is available by proceeding east from Widtsoe Junction on an existing road. This route climbs the Escalante Mountains than proceeds down Main Canyon until it intersects Utah State Highway 12 several miles west of Escalante. Highway trucks would proceed southwest on Highway 12 to Cannonville then use the northern access route to Fourmile Bench Power plant. This routing would eliminate haulage through Bryce Canyon National Park. However, the summit of Escalante Mountain would require snow removal during winter months. The only impact this route would have that is different than those identified in Chapter III is there would be no conflict with tourist traffic in Bryce Canyon National Park.

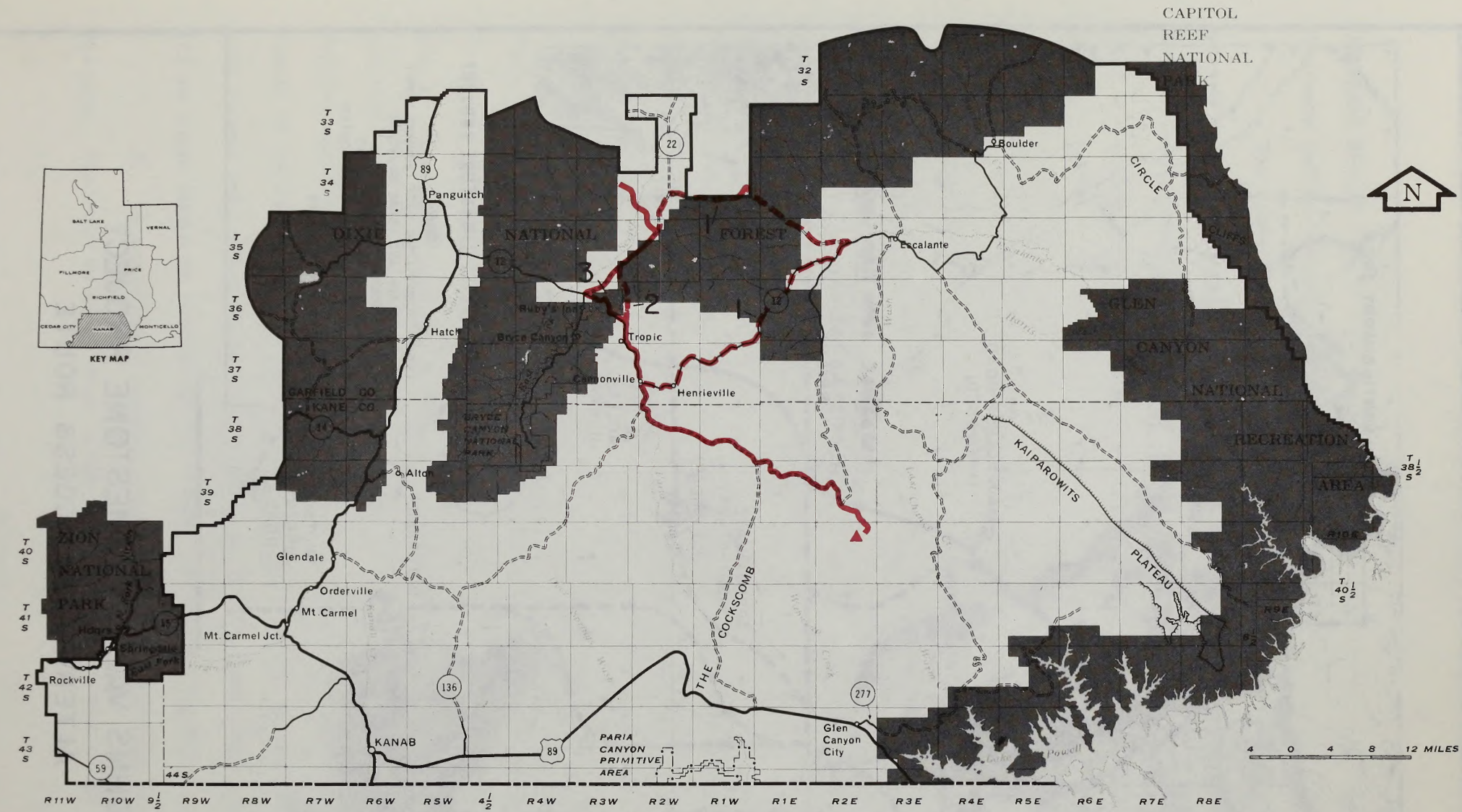
2. A new highway segment could be constructed from the top of Paunsaugunt Plateau. The road to climb this 1,600 foot high escarpment would be 3.8 miles



JOHNS VALLEY LIMESTONE PROJECT

ALTERNATIVE ACCESS ROUTE

ILLUSTRATION 20



ALTERNATE TRANSPORTATION ROUTES

PROPOSED ROUTE

ALTERNATES

KANAB DISTRICT
1974
UTAH

ILLUSTRATION 21

(20,000 feet) long, if an eight percent uphill grade is assumed. Highway design for stable highway cuts could be several hundred feet in height, and extensive fills would affect drainage of this plateau by depositing more sediment into the waterway. Construction scars would be extensive and clearly visible to large areas of northern Bryce Canyon National Park.

3. A "cut off" road could be constructed on private land east of the junction of State Highway 12 and Widtsoe Junction (the "Y" junction). The segment would allow haulage trucks to by-pass the intersection. Approximately three-quarters of a mile of road would be required along flat sagebrush terrain. This approach would disturb approximately five acres of soil and sagebrush. The loss of this vegetation would be insignificant to deer or other wildlife due to the small acreage. Traffic would still be routed through Bryce Canyon National Park.

Alternate methods of surfacing haulage roads

Many alternatives are available for surfacing unimproved roads along the limestone transportation route to suppress fugitive dust. An asphalt surface could be constructed. Such a surface would require approximately 44,000 cubic yards of sand and gravel, which would require a pit approximately 20 acres in size. Disturbance of this acreage could deprive one deer of forage. An asphalt road would control fugitive dust and provide an all weather road.

Chlorides of metal could be used, such as sodium chloride, potassium chloride, and magnesium chloride, to treat the surface to suppress fugitive dust. However, these chlorides, if used over a period of time, could develop a cumulative effect on soils and vegetation causing areas to either support a salt-tolerant vegetation or become barren. The area affected cannot be quantified as it would be dependent on rate and frequency of application and amount of runoff after each storm. This alternative could also result in pollution of ground and surface water.

Alternate methods of transportation

Various systems could be utilized for transportation of limestone. A

railroad could be constructed to the power-generating facility. Another alternative is construction of an overland conveyor belt. These transportation systems would require an intensive construction project for approximately 60 miles. These approaches would disturb an additional 400 acres which in turn would reduce habitat for approximately 10 to 15 head of deer and increase sedimentation in three different drainages, the Sevier, Paria and Wahweap. Exact amount of sediment increase is not known.

Slurrying and pumping the limestone in a pipeline to Fourmile Bench is another alternative to truck hauling. Major disadvantage of this system is the requirement of large quantities of water. Approximately 156,000 gallons per day or 175 acre-feet per year would be required for limestone transportation if a 50 percent by weight, solids is assumed. Water appropriation would come from the Sevier River Drainage and would require purchase of an existing water right, as it is closed to new appropriations. Furthermore, crude limestone would require crushing prior to pipeline transportation thus making it necessary to construct an additional powerline to the quarry site. As was the case with a railroad or overland belt, the slurryline would increase surface disturbance. Also, limestone may be affected by water in the slurry, causing a reduction in its binding characteristics and lowering its effectiveness in SO_2 scrubbers.

Alternate methods of legal disposal

There are two possible methods of disposal of limestone on federal land depending upon whether the limestone is a "common" or "uncommon" variety (as defined under Section 3 of the Multiple Surface Use Act of July 23, 1955, and subsequent court decisions). "Uncommon" varieties may be disposed of by staking of a mining claim by a qualified party under the Mining Law of May 10, 1872, as amended. "Common" varieties can be disposed of by the federal agency having jurisdiction only by sale under the Mineral Material Sales Act of July 31, 1947, as amended. A court decision may be needed to determine if the limestone in question is "common" or "uncommon".

Minerals of all types under state jurisdiction can be disposed of only by state mineral lease.

Regardless of which approach is used to dispose of the limestone impacts to the environment would be the same as those discussed in Chapter III.

Implementation alternatives

Generating plant construction

Access roads

An alternate route for site preparation and construction equipment during initial entry to the site would be from U.S. Highway 89 north on Cottonwood Canyon road to its intersection with Grosvenor Arch road, then east to the Fourmile Bench site. This route is a southern approach on the same road as the proposed access highway.

The section of road from US-89 to Cannonville receives moderate use by local residents and recreationists due to the presence of Kodachrome Basin State Park, Grosvenor Arch scenic area, and cattle operations in the area. It also provides a shorter route to Bryce Canyon National Park for travelers from the south.

The southern part of the road is narrower, longer and generally in poorer condition than the northern segment. Transporting heavy wide loads would conflict with present uses and possibly become a hazard to vehicle operators. All other impacts would be the same as those described in Chapter III.

Construction water source alternatives

A temporary construction water line alternate route would be adjacent to the southern access road beginning at Glen Canyon City. The pipeline would intersect the road at the lower end of Nipple Creek Canyon and follow it to the plant site.

Alternate sources of construction water include the Wahweap arm of Lake Powell, and wells drilled near the plant site. Impoundment of stream water near the plant site would not provide adequate quantities of construction water.

Geological survey studies and coal exploration drilling have been unable to find well water in quantities required for plant site construction. However, the basin area of Wahweap Creek north of Glen Canyon City is a proven well water area, and wells could be developed there as an alternate source for construction water.

Navajo Sandstone, which is the water bearing zone, is considered part of the water storage of Lake Powell and wells in this area could require a water contract. The construction water pipeline could be an insulated above-ground line in some or all of its route rather than being buried. This would create a visual impact until the permanent line was installed and the construction line removed.

Regardless of the alternative used the impacts would be the same as those described in Chapter III.

Coal mine construction

One alternative to the proposed construction method would be a modular design concept. This concept would be to yearly construct a sufficient central facility to handle one operating mine. At the end of the second year, when the second mine would be developed, one additional module would be constructed to support the additional operation. Common facilities would be expanded over a four-year period to meet full production of all four mines. It is proposed that each module would be the same design. Impacts of this alternative would be similar to those discussed in Chapter III for the proposal.

A second alternative would involve staffing of construction projects. It might be possible, should a sufficent underground mining force be available, that miners could develop the second, third and fourth mines. This would eliminate the necessity of hiring an outside contractor for these projects. However, problems of providing living quarters during the initial construction phase would be the same as described in Chapter III.

Another solution to having a large temporary construction force would be to coordinate skills between various Kaiparowits project participants. This envisions that contractor, mine operators, and construction schedule be coordinated so various skills could be utilized by the various parties. This method would require a minimum force of temporary construction workers. Problems of providing accommodations for living space during peak periods of employment would be greatly reduced. The amount

of reduction is not known at this time.

An alternative to conventional shaft-sinking methods would be that of boring some or all of the ventilation shafts. This method involves rotary drilling a small-diameter pilot hole the full length of the shaft. If underground access is available, the pilot hole could be reamed with raise boring equipment to produce a hole several feet in diameter. Sinking crews could then drill and blast rock into the reamed hole, and eliminate the "mucking" step from the production cycle.

Full boring could be accomplished using heavy-duty rotary equipment. A boring machine would be used to cut the shaft to full diameter. Cuttings removal would be achieved by reverse circulation of drilling mud. A casing would be installed for ground support.

Impacts from drilling a small diameter pilot hole the full length of ventilation shafts or using heavy-duty rotary equipment would be the same as those already identified in Chapter III.

Transmission system construction

The structural system of transmission lines must be developed with consideration of equipment and techniques used in construction. If guyed towers are used, the helicopter would be a useful item of construction equipment for tower erection, providing component weights can be kept within lift limits. This system would reduce disturbance to soils and vegetation by reducing the number of access roads.

Capacity greater than 3,000 mw

There are sufficient coal and land resources to support additional increments of generation at the Kaiparowits site. Although at the present time additional units at Kaiparowits are not planned, participants recognize that availability of these resources support future feasibility studies for generation beyond the 3000 mw level. Because lead times for coal-fired facilities are approximately eight years, firm decisions regarding additional facilities for operation in the mid or late 1980's can be deferred for two or three years. At an appropriate time, depending upon system load growth, availability of other fuels, technological developments, economic feasibility including capital availability, and the overall national interest, the participants would consider Kaiparowits as a site for future generation. An Environmental Impact Statement would be required for any such proposal. However, if the Secretary of Interior, acting in the national interest, chooses to implement the alternative for increased capacity as discussed in this section the participants would be receptive.

Potential air quality effects which would result from the alternative of increasing generating capacity above the proposed 3,000 mw capacity were evaluated by the participants. This evaluation determined whether specific increments of generating capacity above 3,000 mw would satisfy the most restrictive air quality standard. Several meteorological plume dispersion conditions were analyzed to determine the specific condition or combination of conditions which would result in the maximum short-term and annual, average ground level concentrations from the station. Based on information provided, compliance with the three-hour sulfur dioxide standard would be the limiting air quality factor regarding dispersion of emissions from Fourmile Bench.

Having determined the limiting air quality standard, a maximum site capacity could be calculated that would not exceed this standard. The participants assumed that additional megawatt capacity would be added in increments of 3,000

mw with the same emission control efficiencies as proposed units. The first increment would be built at right angles to the proposed 3,000 mw. The addition of two more increments, for a total site capacity of 12,000 mw, could be built by completing the square. Additional increments could likewise be added.

Results of site capacity calculations are given in Figure 9. Based on this evaluation, the participants found that up to 25,000 mw capacity could be built at the site without significant danger of exceeding the limiting three-hour sulfur dioxide standard. Compliance with remaining standards at higher megawatt capacities could also be accomplished since relation between expected ground level concentrations and the standard would be better than the limiting factor of the 24-hour SO_2 standard.

FIGURE 9

Site Capacity Predictions *

Megawatt (mw) Capacity	Maximum SO_2 Emission (g/sec)	Estimated three-hour Maximum Ground-Level SO_2 Concentrations (ug/m^3)
3,000	565	187
6,000	1,130	326
12,000	2,260	617
24,000	4,520	1,194
27,000	5,005	1,333

* Based on compliance with the most limiting three-hour SO_2 EPA air quality standard.

Many factors and assumptions have been built into these calaculations, and additional extensive meteorological and air quality data would have to be collected and analyzed prior to actual construction of any additional generating capacity. Concentrations provided above, however, represent the best conservative estimate presently available.

If the generating capacity of the proposed power plant were increased to 6,000 megawatts, it would require approximately 24 million tons of raw coal per day.

Doubling the number of mines would not achieve additional coal production required. Multiple-seam mining would require operation of several additional mines and more sophisticated mine planning and scheduling would be required. In the absence of detailed mining plans, it is estimated that ten or as many as twelve mines would be required to meet the higher generating capacity at the Kaiparowits site.

Water quality impact differences between a 3,000 mw plant and a 6,000 mw plant would be increased diversion of water from Lake Powell, larger salt depositions from cooling tower drift, and increased trace elements in runoff.

Salt deposition from cooling tower drift would increase from approximately 5,830 tons per year to 11,660 tons. If these salts were washed into Lake Powell, thesalinity of the river (assuming an average annual flow of 7,000,000 acre-feet and a total dissolved salt concentration of 700 mg/l at Lee's Ferry, Arizona) would increase approximately 1.5 mg/l. As a frame of reference, 700 mg/l of dissolved salts in 7,000,000 acre-feet of water represents 6,100,000 tons of salt.

Withdrawal of 102,000 acre-feet of water per year from Lake Powell would increase the salinity of the Colorado River at Lee's Ferry, Arizona, less than 1 mg/l. This conclusion is contained in a statement presented by Herbert S. Riesbol to the U. S. Senate Interior and Insular Affairs Committee at hearings on effects of large thermal electric plants on quantity and quality of flows in the Colorado River.

The 102,000 acre-feet of water that would be diverted for possible use at Kaiparowits has been included in future development plans by the State of Utah and the Upper Colorado Region Comprehensive Framework Study. In 1973, consumptive water use of diversions by Utah from the Colorado River system was approximately 680,000 acre-feet out of a total allocation of approximately 1,350,000 acre-feet.

Greater quantities of limestone would be required in rock dusting the coal mines and to mitigate SO_2 emissions from a 6,000 mw power-generating facility. Limestone quarrying operations would increase production to approximately 2,200 tons per day. Requirements for manpower, equipment, and the amount of highway transpor-

tation would also increase. As production level increased, there would be a corresponding increase in surface disturbance and excavation.

Illustration 22 shows a conceptual transmission line arrangement and proposed routing for the alternative 6,000 mw Kaiparowits generating station. The following lines represent the "maximum requirement" for 500 kv AC expansion from the 3,000 megawatt proposal to the 6,000 megawatt alternative:

1. Kaiparowits - Eldorado
2. Kaiparowits - Moenkopi
3. Moenkopi - Mohave
4. Eldorado - Mira Loma (via Lugo Substation)

The Eldorado - Mira Loma (via Lugo) line would parallel existing Eldorado - Lugo and Lugo - Mira Loma lines. All other lines would follow corridors proposed for the 3,000 mw level.

Additional routes are feasible for transmission line construction, however environmental studies have not been made to assess their impact. If additional lines were constructed adjacent to proposed 3,000 mw lines and proposed access roads utilized, additional impact would be minimized. Where 2,000 foot separation would be required for additional lines, new access roads would be constructed thus increasing the impact.

Illustration 23 indicates location of microwave communication sites that would be needed for expansion to the 6,000 mw level.

KAIPAROWITS TRANSMISSION SYSTEM 6000 MW LEVEL

LEGEND

- INTERSTATE HIGHWAY
- U.S. HIGHWAY
- STATE HIGHWAY
- STATE BOUNDARY
- COUNTY BOUNDARY
- S.C.E. CO. EXISTING 500KV T/L
- S.C.E. CO. PROPOSED 500KV T/L
- CITY OF LOS ANGELES - DEPT. OF WATER & POWER T/L
- ARIZONA PUBLIC SERVICE EXISTING T/L'S (2)
- ARIZONA PUBLIC SERVICE PROPOSED T/L

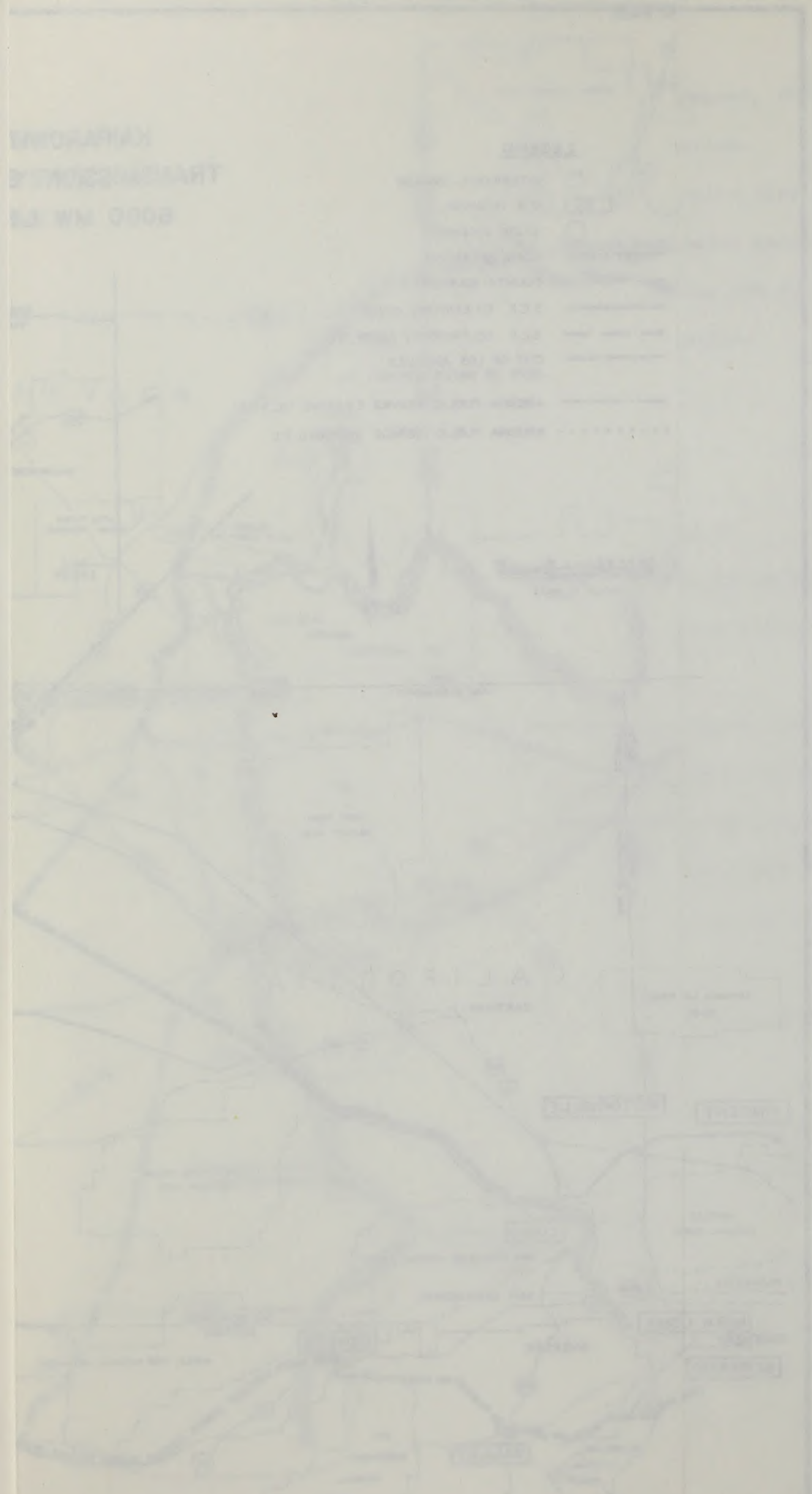
SCALE IN MILES 10 8 6 4 2 0 10 20

N

FOURMILE BENCH SITE
NAVAJO
MOENKOPI
McCULLOUGH
ELDORADO
MOHAVE
KINGMAN
NEEDLES
VINCENT
VICTORVILLE
LUGO
MIRA LOMA
SERRANO
DEVERS
VALLEY
WESTWING
PHOENIX
FLAGSTAFF
PRESCOTT
LAS VEGAS
BARSTOW
PASADENA
SAN BERNARDINO
RIVERSIDE
ROSEMEAD

NEVADA
UTAH
ARIZONA
CALIFORNIA

ILLUSTRATION 22



KAIPAROWITS TRANSMISSION SYSTEM
6,000 MW LEVEL
PROPOSED ROUTES AND MICROWAVE STATIONS

LEGEND

- S.C.E. CO. PROPOSED 500 KV T/L
- PROPOSED MICROWAVE STATION
- EXISTING MICROWAVE STATION
- ARIZONA PUBLIC SERVICE PROPOSED 500 KV T/L
- SUBSTATION
- GENERATING STATION

SCALE IN MILES 10 8 6 4 2 0 10 20

N

PROPOSED ROUTE ELDORADO - KAIPAROWITS NO. 1 & NO. 2 500 KV T/L'S

PROPOSED ROUTE ELDORADO - LUGO 500 KV T/L

PROPOSED ROUTE LUGO - MIRA LOMA 500 KV T/L

PROPOSED ROUTE DEVERS - SERRANO NO. 1 & NO. 2 500 KV T/L'S

PROPOSED ROUTE DEVERS - MOHAVE NO. 1 & NO. 2 500 KV T/L'S

PROPOSED ROUTE KAIPAROWITS - MOENKOPI - MOHAVE NO. 1 & NO. 2 500 KV T/L'S

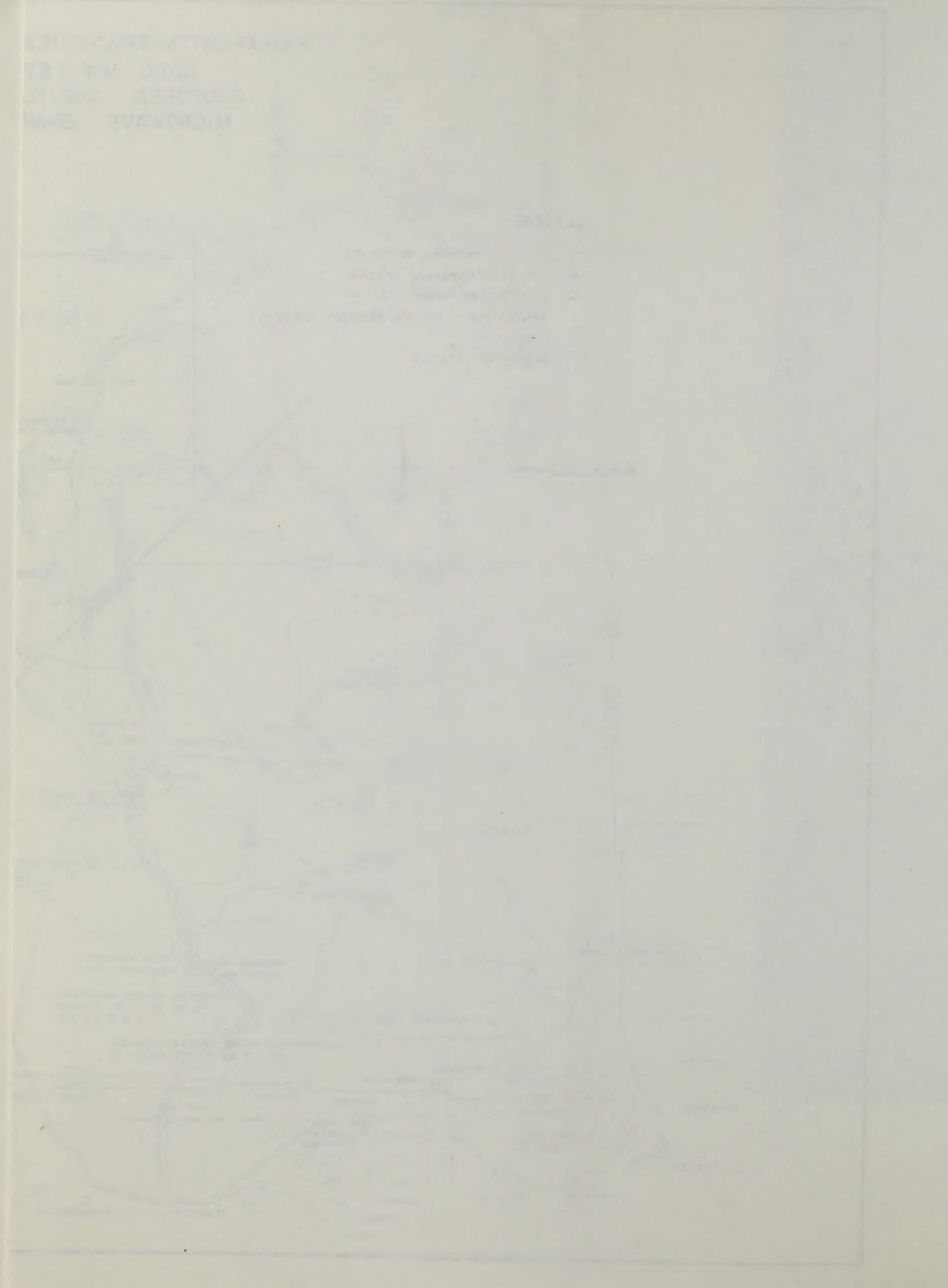
PROPOSED APS KAIPAROWITS - NAVAJO 500 KV T/L

PROPOSED APS KAIPAROWITS - WESTWING NO. 1 & NO. 2 500 T/L'S

CEDAR CITY, DIXIE NATIONAL FOREST, ZION NATIONAL PARK, BEAVER DAM, ST. GEORGE, KANAB, PIPE SPRINGS KAIBAB INDIAN RESERVATION, FOURMILE BENCH PLANT SITE, FOURMILE, NIPPLE, BUCKSKIN, INTAKE, NAVAJO, GLEN CANYON NATIONAL RECREATIONAL AREA, PARIA PRIMITIVE AREA, VERMILLION CLIFFS NATURAL AREA, COPPER MINE, PRESTON MESA, MOENKOPI, UTAH, NEVADA, ARIZONA, CALIFORNIA

LINCOLN COUNTY, CLARK COUNTY, WASHINGTON COUNTY, KANE COUNTY, COCONINO COUNTY, MOHAVE COUNTY, INYO COUNTY, SAN BERNARDINO COUNTY, RIVERSIDE COUNTY, LOS ANGELES COUNTY, YUMA COUNTY, YAVAPAI COUNTY, MARICOPA COUNTY, NAVAJO COUNTY

GLENDALE, DESERT GAME RANGE, SHEEP MTN. GUNNERY RANGE, APEX, NELLIS AIR FORCE BASE, LAS VEGAS, RED MTN., ELDORADO, NELSON MTN., LAKE MEAD NATIONAL RECREATIONAL AREA, LAKE MEAD, COLORADO RIVER, GRAND CANYON NATIONAL MONUMENT, GRAND CANYON NATIONAL PARK, KAIBAB NATIONAL FOREST, KAIBAB RESERVATION, HUALAPAI INDIAN RESERVATION, CAMP IRWIN MILITARY BASE, EDWARDS AIR FORCE BASE, BARSTOW, CLIPPER MTN., FLAT TOP, NEEDLES, RODMAN MTN., QUARTZITE MTN., LUGO, TWENTYNINE PALMS MILITARY BASE, CHEMEHUEVI VALLEY INDIAN RESERVATION, COLORADO RIVER INDIAN RES., ANGELES NATIONAL FOREST, STRAWBERRY PEAK, SAN BERNARDINO NATIONAL FOREST, PASAOENA, SAN BERNARDINO, SNOW PEAK, VISTA, MIRA LOMA, RIVERSIDE, ROSEMEAD, DEVERS, PALM SPRINGS, SANTIAGO PEAK, SERRANO, CLEVELAND NATIONAL FOREST, VALLEY, SAN BERNARDINO NATIONAL FOREST, JOSHUA TREE NATIONAL MONUMENT, MECCA, CHUCKWALLA, LITTLE GRANITE, SPIRIT MTN., MOHAVE PASSIVE, MOHAVE, KINGMAN, HUALAPAI, BILL WILLIAMS MTN., WILLIAMS, FLAGSTAFF, PRESCOTT, PRESCOTT NATIONAL FOREST, TOWERS MTN., HUTCH MTN., MT. ELDON, O'LEARY PK., WESTWING, PHOENIX, TONTO NATIONAL FOREST



ALTERNATIVE OF CONSTRUCTING PLANT AT NIPPLE BENCH

Description of action

Unless described otherwise, all actions and alternates for Nipple Bench are identical to actions and alternates for Fourmile Bench. The following section describes only those proposed actions and alternatives for Nipple Bench that would be different from proposed actions and alternatives for Fourmile Bench.

Generating plant

Site arrangement

In order to develop the optimum site layout of the Nipple Bench site, various alternates were considered. Construction and operating constraints were analyzed as well as physical characteristics of the site. The latter include topography, drainage, wind direction, vegetative cover, and archaeological considerations.

Legal description of land included within site boundaries (approximately 4,160 acres), is as follows:

Township 42 South, Range 3 East, S.L.M.

Section 7: all
Section 8: all
Section 9: all
Section 17: all
Section 18: all
Section 19: N½
Section 20: all

The site consists of uneven terrain bordered by several steepwalled canyons on the east and south. A rounded ridge runs east-west through the center of Section 18; it divides in Section 17 into branches which run northeast and southeast. Below this ridge, slopes range up to five percent on all sides. To the north, a broad, shallow drainage area runs east to a steep dropoff in Tibbett Canyon east of the proposed site. Vegetation consists mainly of low shrubs and grasses with

few plants larger than three feet in height.

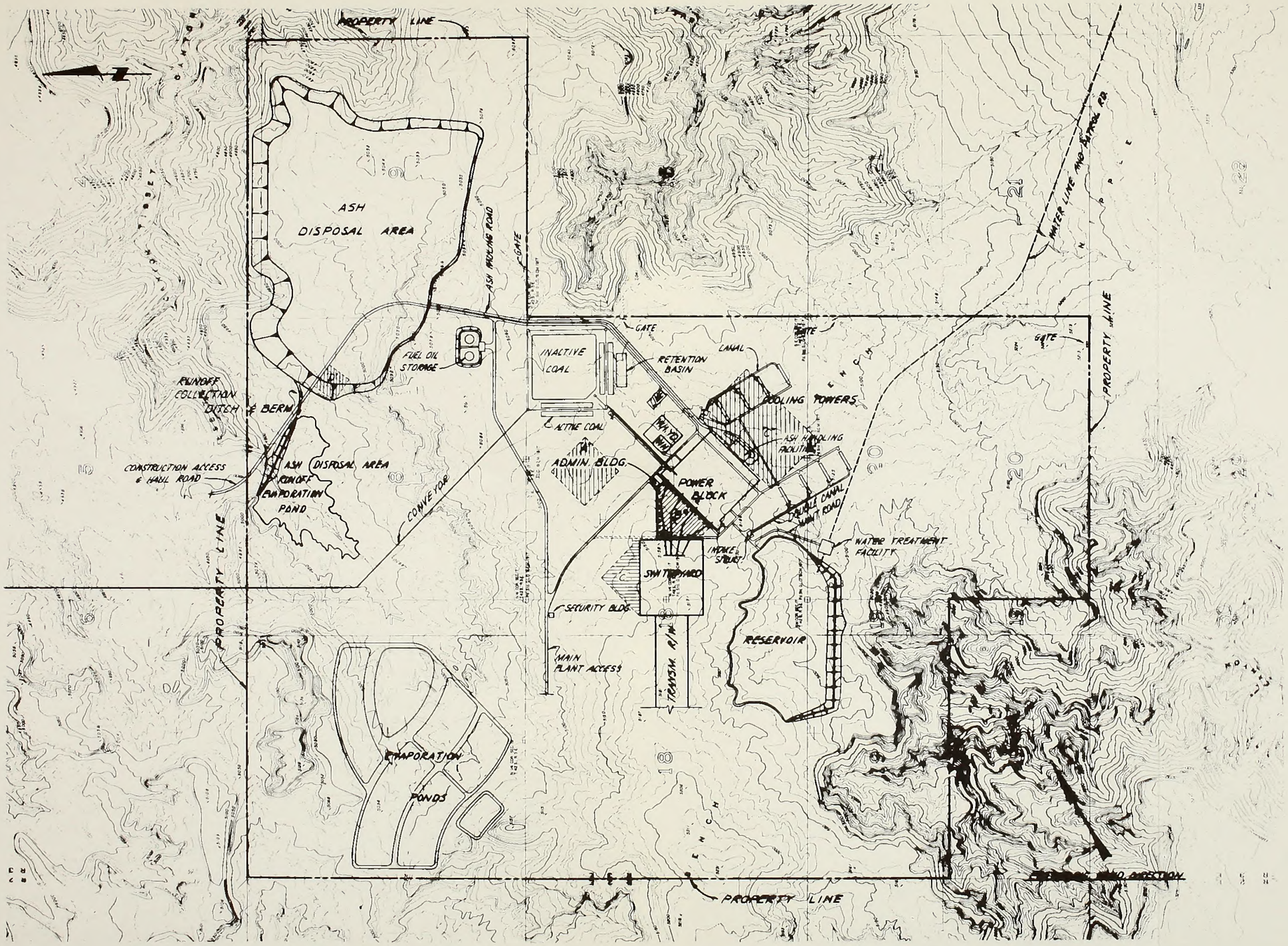
As shown in Illustration 24, major site components would be located at the ridge junction in Section 17. These would include the power block, electric power switchyard, cooling towers, in-plant ash handling facilities, coal storage areas, limestone preparation plant, administration building, shop and warehouse. Figure 10 shows the acreages involved in the Nipple Bench alternatives for the generating station and support facilities.

In addition to vehicular access to these facilities, several major systems would tie into the power block from off-site corridors. The principal transmission corridor would enter from the west. The switchyard would be placed along the east-west ridge so that line exits would be directly into this corridor.

Water and coal supply lines would enter the site from the southeast and north, respectively. The water line would terminate at a reservoir, and secondary systems would supply water to plant facilities. Most of the water would go to the cooling tower system to replace evaporation losses. The coal supply conveyor would terminate at the active and inactive coal storage areas from which the plant coal system would supply coal to the units. Coal areas would be placed north of the power block nearer to the point of coal entry.

The low drainage area north of the proposed power block would be suitable for water containment facilities. It was selected for the proposed evaporation ponds due to the large area available. Approximately 235 acres of ponds would be required for the full 35-year life of the plant compared to the reservoir surface area of approximately 130 acres. The lower elevation of this area would aid in delivery of waste water to the ponds. In addition, this location would be at the opposite side of the power block from the water line entry point necessitating an excess of piping if it was used as a reservoir site. Individual evaporation ponds would be laid out to roughly conform to contours in this area to minimize their grading impact.

Terrain immediately south of the power block would provide a favorable location for the 2,640 acre-foot water reservoir. This location would be near the



GENERAL NOTES

1. POTENTIAL AREAS FOR USE DURING CONSTRUCTION;

   A. CONSTRUCTION CAMP
   B. CONSTRUCTION FACILITIES
   C. LAYDOWN
   D. BATCH PLANT

800 0 800 1600 2400

SCALE IN FEET
1" = 800'

SITE PLAN
NIPPLE BENCH SITE
KAIPAROWITS GENERATING STATION

ILLUSTRATION 24



FIGURE 10

Nipple Bench Power Plant Proposal

Generating Plant	Acres Disturbed During Construction	Acres Permanently Occupied After Construction
1. Power Block incl. Switchyard	215	80
2. Coal Storage	105	85
3. Fuel Oil Storage	15	10
4. Cooling Towers	95	5
5. Evaporation Ponds	260	235
6. Buildings & Parking	Incl. in 1	Incl. in 1
7. Ash Disposal	460	460
8. Ash Disposal Reservoir	75	55
9. Ash Haul Road	10	10
10. Water Storage Reservoir	145	130
11. Retention Pond	5	5
Total	1,385	1,075
Water pipeline		
1. Pipeline	250	80
2. Pump Station (Lake)		
3. Pump Station (Nipple Bench)		
4. Patrol Road	75	40
5. Power Line	Incl. in 4	Incl. in 4
Total	325	120
Access Highway (70.9 Miles)		
1. Glen Canyon City to Nipple Bench and Coal Mine (24.6 Miles)	150	105
2. Nipple Bench to Cannonville, Utah (46.3 Miles)	280	195
Total	430	300

entry point of the water line and would be conveniently located with respect to the power block.

Various sites were investigated for a disposal area for 60 million cubic yards of ash and SO_2 sludge. The proposed site would be northwest of the main site facilities on slopes leading into the northern drainage area. This location is an isolated drainage area where erosion protection would be minimized. It would be close to the power block, and a 60-foot wide haul road would be laid out on the most direct alignment between ash and sludge handling facilities and disposal area. This road would avoid the inactive coal pile and a bridge crossing of the coal conveyor.

A storage facility would be required for fuel oil used during unit start-up and in main coal burner ignition. This facility would consist of two 150,000-barrel capacity, steel fuel oil tanks. Each tank would be surrounded by earth dikes capable of containing the total volume of oil. Fire prevention and control systems would be provided as described in Chapter I. The storage area would be downwind of and distant from all plant facilities.

In order to avoid excessive stripping of vegetation from the site for temporary facilities, construction area, where possible, would be in areas designated for construction later in the project schedule. The cooling tower area would be used for main construction laydown. Space between the power block and switchyard would be for shops and offices during construction as this area must be graded eventually to allow placement of transmission towers and maintain powerline clearances. The construction camp would be separate from the main plant construction area. Grading would be minimized and vegetation retained where practical.

In all cases, plant site development would be accomplished with the intention of preserving a maximum amount of native vegetation. Several technical and economic reasons exist for preserving this vegetation, in addition to avoiding extra costs for stripping and removing such vegetation. Primarily, all vegetation left

undisturbed would aid in erosion protection and reduce storm runoff resulting in an economic savings through erosion control.

Grading of the power block and related equipment area would be an interconnected multi-level system of essentially flat areas. The power block area would be graded entirely but cut with foundations resting on in-place material. Bearing capacities of these in-place materials are rated at 15 to 25 tons per square foot and differential settlement of power block foundations would not occur. This grading plan would result in an excess of cut material from the power block area which would be used in the ash disposal area. Following site approval and prior to actual construction, additional foundation investigation would be performed. At this time a detailed study would be made regarding use of these excavated materials as foundation subbase. If they were suitable, a balanced cut and fill approach would be used in the power block, eliminating a large portion of excess material.

Elevations in areas directly related to the power block would be established largely by the power block elevation. Support buildings would be included in the power block cut to allow ready access between them. A uniform grade would be established between power block and switchyard, allowing a balanced cut and fill approach in grading of the switchyard. To facilitate use of open circulating water canals in the cooling tower area, some excess cut material from the power block would be used to elevate this area. Differential settlement is not expected to be a significant problem here since foundation loadings are lighter. The coal storage area would also be raised to reduce the angle of the plant coal supply conveyor.

The grading design would result in an approximate material excess of 3½ million cubic yards, including the evaporation ponds. This material would be mainly sandstone rock fragments up to two feet in size and other material unsuitable

for structural fill. This material would be removed to the ash disposal area and placed as a spoils pile in a portion of this area. During plant operation, this material would be incorporated into the ash and sludge fill.

Where possible, major drainage channels would be avoided by plant facilities. One major exception to this would be the channel at the north side of the plant near the ash and sludge disposal area. To minimize total grading impact, the proposed runoff collection pond for this area would be located in the drainage channel. Runoff would be collected and carried by culvert around the pond and released into the natural channel on the downstream side. As an alternative, the size of the evaporation pond could be increased to retain all runoff from the upstream area.

All runoff from material storage and construction activity areas would be retained in a retention basin. Other plant areas would be drained to natural drainage channels. This plan conforms to Effluent Guidelines and standards established by the Environmental Protection Agency. The retention basin would be equipped with an oil-water separator which would remove industrial wastes and allow release of this water to a natural watercourse once it has satisfied EPA effluent guidelines and standards. These standards state that total suspended solids shall not exceed 50 mg/l, and the pH shall be within the range of 6.0 and 9.0. If these standards cannot be met, contents of the retention basin would be pumped to the liquid waste evaporation ponds.

The retention basin size is based on a 24-hour, 10-year recurrence interval rainfall amount (Two inches in 24 hours). It would cover one acre with a depth of 15 feet, including a three-foot freeboard and a maximum water level of 12 feet. A mudstone lining one foot thick would prevent degradation of groundwater.

Since this basin would function only as a holding basin, it would normally be maintained at water depths of less than two feet except during or

immediately following a rainfall. It would fill to maximum depth only when the previously mentioned rainfall is met or exceeded.

A spillway would be provided in the retention basin to prevent overflow of the containment dike in the event of rainfall exceeding the design amount. This flow would be released into a natural drainage channel. In the unlikely event that such spillway flow should occur, the mixing of this relatively small flow with major amounts of uncomtaminated runoff from other sources would result in sufficient dilution to minimize its effect.

Power block - boilers and turbines

The generating plant at the alternate location on Nipple Bench would be similar to the plant at the Fourmile Bench site as described in Chapter I.

The Nipple Bench location would influence size and horsepower of equipment which would depend on outside air density and atmospheric pressure. Such equipment as boilers, fans, air compressors and various controls would have to be designed to operate at the higher atmospheric pressure and air density of Nipple Bench. Nipple Bench is 5,100 feet above sea level as compared with the Fourmile Bench elevation of 6,100 feet above sea level.

Some components, such as stacks, would be influenced by changes in terrain and surrounding environment. The proposed plant would have four stacks. Due to differences in terrain and meteorological conditions of the two sites, the Nipple Bench site would require higher stacks to achieve the same stack emission dispersion as that of stacks at the Fourmile Bench site. The stacks would be approximately 800 feet high (600 feet for Fourmile Bench) with a bottom outside diameter of approximately 60 feet and top outside diameter of approximately 30 feet. Because of the more dense air at Nipple Bench, boilers and air and gas handling equipment would be approximately five percent smaller than at Fourmile Bench.

Evaporation ponds

Evaporation ponds at the Nipple Bench alternate location would be similar to Fourmile Bench site evaporation ponds, as described in Chapter I. The Nipple Bench location would influence location and lining of evaporation ponds as described below.

Evaporation ponds would be in Section 7 which is in the northwest corner of this plant site rather than the southern corner, as at Fourmile Bench. This location at Nipple Bench would eliminate the necessity for major flood control provisions.

To prevent pollution of groundwater, ponds would be lined with a maximum two-foot layer of clay. This material would be obtained from deposits of Tropic Shale along the proposed Nipple Creek main access corridor from Glen Canyon City to the Nipple Bench Site. The clay has a permeability coefficient of 0.05 feet/year and a two-foot layer would provide an adequate lining for the life of the plant. A six-inch layer of on-site material would be placed over the clay to protect it from damage from wetting and drying action, waves or weathering.

Since water management records would be kept for the evaporation ponds, leakage caused by a possible break in the lining would be detected through the groundwater monitoring system. Although this is not likely with a clay lining, it would be repaired if it occurs.

The ponds would handle service waste and effluent from the sewage treatment plant. All ponds would be designed using the same criteria as for the Fourmile Bench site to assure that no degradation of groundwater or Lake Powell would occur.

Access roads

Nipple Bench and the proposed coal mine can be reached by four-wheel-drive trails which allow fair weather and limited vehicle access only. These

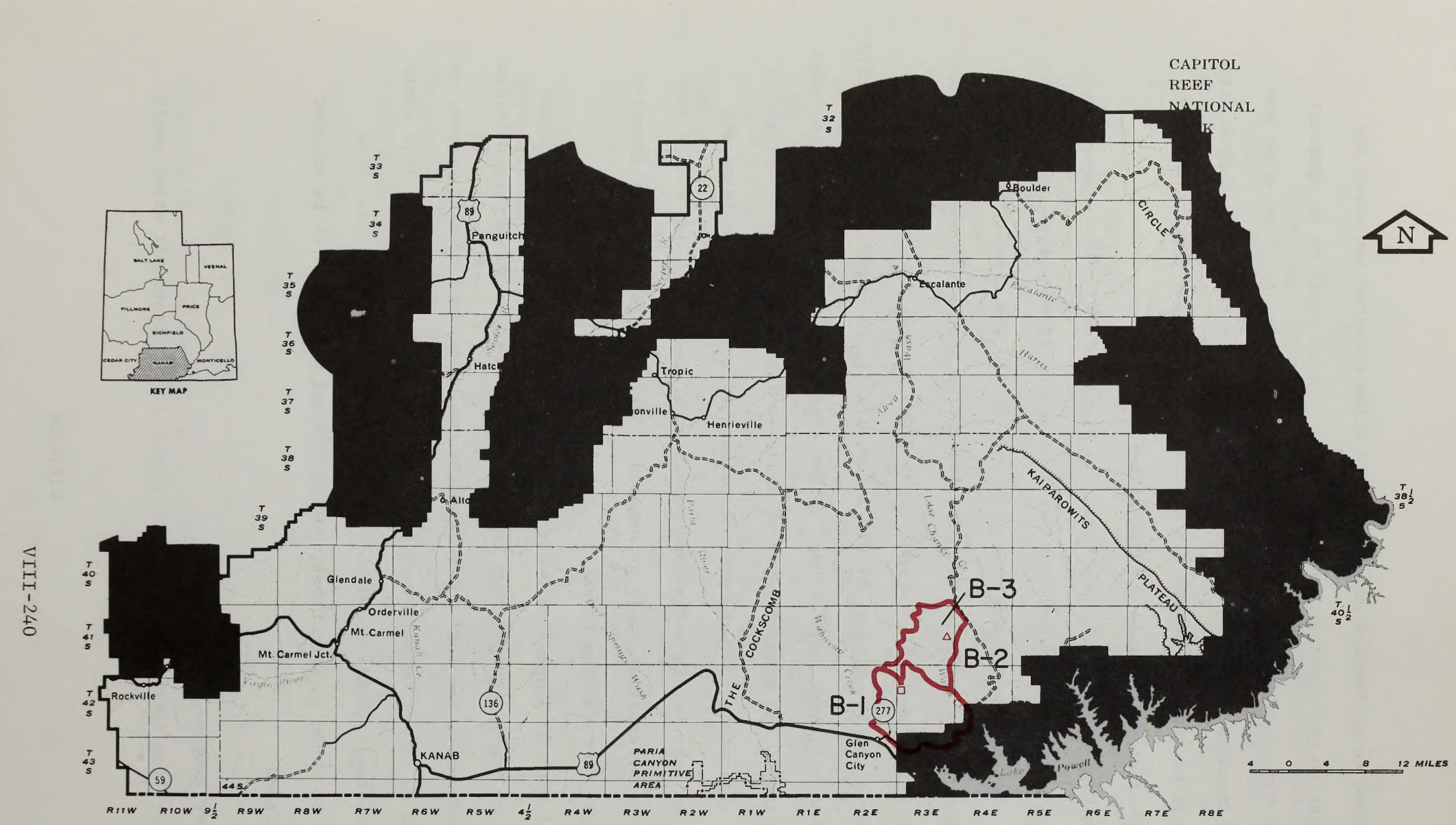
trails would have to be leveled and widened to allow construction crews and equipment to get to the plant site and coal mine. There would be no apparent reason or need for access from the north (Cannonville area) to these areas and access road alternates to Nipple Bench are from the south only (Glen Canyon City area). Segments of the access road alternates for the Nipple Bench site are discussed below and are shown in Illustration 25.

Glen Canyon City to Nipple Bench via Nipple Creek: This road segment would be approximately 14.2 miles long, with no grades steeper than four percent. Vegetation is very sparse through most of Nipple Creek. The area at the mouth of Nipple Creek and at Nipple Spring has more vegetation, but still would fall into the sparsely vegetated category. Light brush grows in scattered areas and there are a few trees at Nipple Spring. Nipple Bench, itself, has very little vegetative cover other than scattered small brush. Three stream crossings would be included within this segment. An exposed layer of shale is found over a short section of Nipple Creek; this shale has very poor characteristics for road building and would have to be kept moisture-free and possibly excavated to a depth such that its swelling characteristics could be negated. Aggregate for road construction would be brought from Wahweap Creek.

Coal mine to Nipple Bench via Tibbet Canyon: This 10.4 mile segment would contain no grades steeper than four percent and would include seven stream crossings. Basically, the full route from the coal mine down Missing Canyon, up Warm Creek and up Tibbet Canyon would be in narrow, winding canyons. This route is also only sparsely vegetated with light brush and very few trees. Some aggregate can be found in Warm Creek, but additional would have to be brought from Wahweap Creek.

Water storage

Water from Lake Powell would be pumped to the reservoir which would



NIPPLE BENCH ACCESS ROAD ALTERNATIVES

KANAB DISTRICT
1974
UTAH

ILLUSTRATION 25

provide continued service to the plant in the event of an outage of the water make-up system. The proposed reservoir size is based on the reliability of the make-up water pipeline and an economic study of reservoir size versus increased pipeline size. The reservoir would occupy approximately 130 acres of land with a 65 acre surface area and a 40-foot average depth. It would contain approximately 2,640 acre-feet (860,000,000 gallons) of water, enough to supply the station for 14 days at maximum capacity during the hottest summer month.

The reservoir would be in the southwestern portion of the site just upstream of Thompson Canyon. This location would take advantage of a natural bowl-shaped area to minimize earthwork required for the reservoir. This location would also be desirable because it has a very small tributary drainage area upstream of the reservoir, greatly reducing the chance of a significant increase of flow to the reservoir from storm runoff. The reservoir would also be located so a safe drainage path was provided for flood waters in the event some mishap should cause breakage in the dam.

The dam design would be developed using a dynamic stability analysis. Predominatly on-site materials would be used to construct the dam which would have an upstream slope of four horizontal to one vertical and a downstream slope of three horizontal to one vertical. The crest width of the dam would be 30 feet with a maximum 24-foot-wide asphaltic concrete paved road encompassing the reservoir. The reservoir would have an inlet structure, a three foot diameter concrete encased pipeline through the dam fill and a pump structure at the downstream toe of the dam which would pump reservoir water to the power block.

The minimum freeboard (the difference in elevation between the crest of the dam and maximum reservoir water surface) would be five feet. The normal freeboard (the difference in elevation between the crest of the dam and normal reservoir water level) would be six feet. The reservoir would be designed so a 100-year storm can occur at the normal reservoir water level and not release

flows through the spillway. The spillway would be designed for flows well in excess of a 100-year storm and would conform to the minimum spillway capacity required for dam construction in Utah.

The reservoir would be lined with a minimum of six inches of clay material. This would reduce seepage rate of the reservoir to approximately 300 acre-feet (186 gpm) of fresh water per year. Upstream slopes of the dam and interior slopes of the reservoir would be protected against destructive wave action by placing large stones from the crest of the dam to several feet below minimum water level. Downstream slopes of the dam would be protected against erosion by wind and rainfall runoff by a layer of rock approximately one foot thick.

Solid waste disposal

All aspects of solid waste disposal are similar to those presented in Chapter I for the Fourmile Bench site.

The selected disposal site would be a bench-top landfill site in the northeast corner of the site area in Sections 8 and 9. The area is on a gradual slope on the south side of Nesbitt Canyon immediately upstream of the canyon rim. This location necessitates some re-routing and retention of upstream runoff but erosion potential of the ash fill would be minimized by locating the upper perimeter along the crest of the ridge.

Details for placement of both ash and sludge in this area would be as previously described for Fourmile Bench.

In addition, at Nipple Bench the collection pond has been designed to retain and evaporate the maximum annual 23-inch rainfall from a 100-year storm falling on the ash disposal area and adjacent minor tributary runoff areas. This pond would occupy approximately 57 acres.

An earth dam approximately 30-feet high would be built for the pond to retain 430 acre-feet (140 million gallons) of storm runoff. Material for the dam would come from the interior of the landfill site and require 180,000 cubic yards

of excavation. The dam would probably consist of dense sandstones for ballast with an impervious core made from clays in the plant area.

Coal mine

Construction of the power plant on Nipple Bench would have no significant impact upon the proposed coal mine other than to cause relocating of virtually all coal mine related facilities to efficiently direct movement of coal to the south, toward Nipple Bench, instead of to the northwest, toward Fourmile Bench. Mine locations, coal washery, conveyor belts and all related surface facilities would be relocated.

Coal leases held by the participants are independent of land used as a power plant site. Therefore, regardless of where the power plant may be located, coal reserves scheduled to be mined would remain the same.

Construction and operation schedules and plans for coal mines with a Nipple Bench power plant site would be essentially identical to schedules and plans for a Fourmile Bench site. Both schedules call for a four-year construction project. Overall construction effort for the two sites would be almost identical, and savings in construction effort realized in one aspect would likely be expended in another.

Transportation alternatives

Because of the difference in elevation between the Fourmile Bench power plant site and the coal mines, conveyor belt transportation of coal is the only economically feasible technique of coal delivery. However, if the power plant site were located on Nipple Bench, no significant difference in elevation would exist and coal transportation could be by conveyor belt or by railroad, depending upon an overall economic analysis of the project. The participants have proposed railroad transportation as a possible alternative to conveyor belt transportation if the power plant were located on Nipple Bench.

A decision between the three proposed alternatives is difficult prior to

conducting an overall economic analysis. Such an analysis is impossible at this time due to conceptual design of project proposals.

Transmission system

Introduction

If the Kaiparowits Plant were built at Nipple Bench instead of Fourmile Bench, there would be four alternate transmission system routes. One would consist of a single 500 kv line to Eldorado Substation. The second route would consist of three parallel 500 kv lines to Navajo Generating Station, Westwing Substation, and the Mohave Generating Station. The third alternative would be the Ty Hatch route to Eldorado Substation and the fourth would be the Wahweap alternate.

Nipple Bench to Eldorado alternate route

This route would commence at an arbitrary point at the northwest corner of the Nipple Bench site and proceed due west seven and one-half miles to join the East Clark Bench alternate route for the Kaiparowits to Eldorado proposed route. In the first mile, the route would cross edges of some tributary washes which lead into Nipple Creek. Some deviation from the route shown may be required to adjust lines to terrain. After three miles, there would be a 500-foot drop in elevation to Wahweap Basin. This drop would occur in essentially two stages. The first stage would consist of about 400 feet to where the slope flattens out enough for good tower locations. The next stage would be a drop of 100 feet or more to the Wahweap drainage system. As the route proceeds west, it would cross uneven terrain near Wahweap Creek. After crossing the Creek the route would rise about 250 feet in elevation as it climbs out of Wahweap Basin onto the East Clark Bench Plateau, and would continue to a junction with the East Clark Bench route.

Alternate route from Nipple Bench to Navajo Generating Station, Westwing Substation and Mohave Generating Station

This route would begin at the southwest corner of the Nipple Bench Site

and proceed west for about one mile to the proposed John Henry alternate (see Chapter VIII). At this point the proposed route would turn south and follow the John Henry alternate and then the proposed route from the Fourmile Bench site. Lengths of the proposed alternate routes from the Nipple Bench site would be: 1) Nipple Bench to Navaho Generating Station - 33 miles; 2) Nipple Bench to Westwing - 284 miles; and 3) Nipple Bench to Mohave Generating Station - 295 miles.

Ty Hatch alternate (Illustration 26)

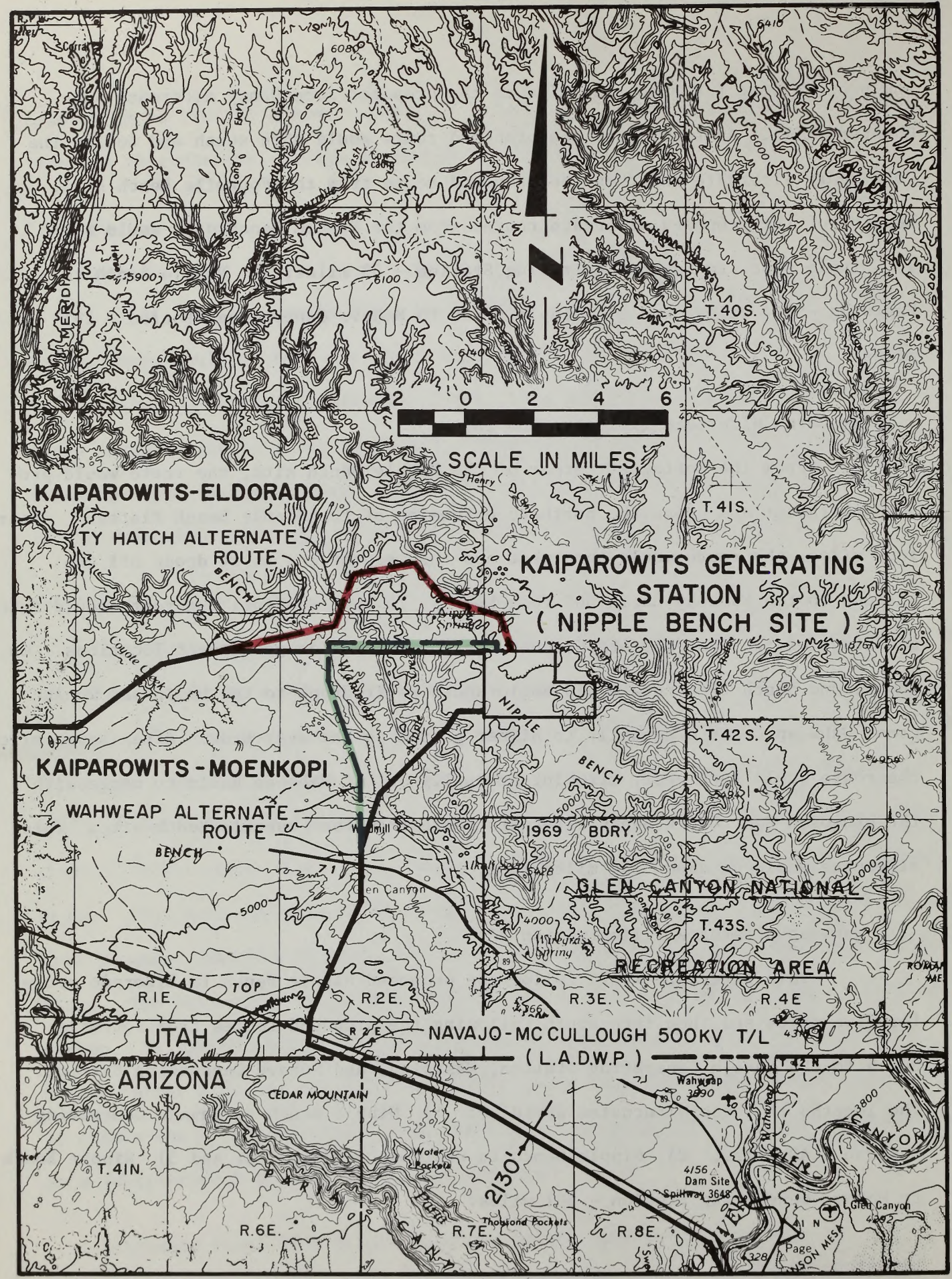
From the northwest corner of the Nipple Bench site, the route would proceed northwest and cross the northern extension of the Nipple Bench Plateau. After four miles, the route would turn west and then southewest as it drops off the plateau to the Wahweap Basin 600 feet below. In this descent, the route would take advantage of two intermediate benches that would provide good tower locations. On the second bench the route would angle south as it drops to the basin and would cross Wahweap Creek diagonally to higher ground on the west side. After seven miles, the route would turn west, climbing gradually out of Wahweap Basin to merge with the proposed East Clark Bench alternate route from the Fourmile Bench site. This alternate would be about 264 miles long.

Wahweap alternate (Illustration 26)

This alternate would follow the proposed Nipple Bench to Eldorado route for five miles and then turn south following the proposed routes from Fourmile Bench to the Navajo Generating Station, Westwing, and Mohave Generating Station. The lengths of these alternates would be: 1) Nipple Bench to Navajo Generating Station - 40 miles; 2) Nipple Bench to Westwing - 290 miles; and 3) Nipple Bench to Mohave Generating Station - 301 miles.

Limestone quarry

If the generating plant were constructed on Nipple Bench, limestone usage



NIPPLE BENCH TO ELDORADO PROPOSED ROUTE

TY HATCH ALTERNATE ROUTE

WAHWEAP ALTERNATE ROUTE

ILLUSTRATION 26

and production required would remain the same. The only effect that the Nipple Bench plant site location would have on the proposed Johns Valley quarrying operation would be an increase in haulage distance of approximately 20 miles, making the total haulage distance about 80 miles. The Canaan Peak alternate quarry site would be the closest proposed site to Nipple Bench (about 40 miles haulage distance).

Stages of implementation

Site access

Initial access to Nipply Bench for site preparation would be from Glen Canyon City, east to the existing Tibbett Canyon four-wheel-drive road and to the site. The permanent access and heavy haul route from Glen Canyon City up to Nipple Creek to the site would be graded during site preparation as required for automobiles and lowboy trailers. This road would be used for access while being improved for heavy haul.

Construction power

Construction power would be obtained from the existing transmission line and tapped at the closest point on the Kaiparowits-Navajo transmission corridor.

Construction water

Construction water pipeline would be adjacent to the patrol road in the permanent water line corridor to Nipple Bench.

Alternate sources of construction water would be wells in Wahweap Basin north of Glen Canyon City, with the alternate pipeline following the proposed access road.

Aggregate source and transport

The aggregate source would be from an existing developed deposit in Wahweap wash north of Glen Canyon City. The aggregate would be processed at the source area, eliminating the need for a processing facility at the Nipple Bench site. Aggregate trucks would use the construction access road developed from Glen Canyon City to the site.

Description of existing environment

Generating plant facilities

Nipple Bench is located 14 miles south-southwest of Fourmile Bench and 21 miles northwest of Navajo Power plant. The proposed site elevation (5,200 feet above mean sea level) is 1,000 feet lower than Fourmile Bench. The proposed site on Nipple Bench is situated on a relatively flat plateau with elevated terrain, six to twelve miles north, rising approximately 1,000 feet above the site. Fiftymile mountains rise approximately 2,000 feet above the site 27 miles northwest and east. Eighteen miles to the west, Cockscomb Ridge is approximately 7,000 feet high, and 30 miles northwest the Canaan Mountains rise to over 9,000 feet in elevation. Approximately six miles to the south, the terrain drops 1,000 feet.

Climate

Small differences in temperature, relative humidity, precipitation, and evapotranspiration exist between Fourmile Bench and Nipple Bench because of the 1,000 foot difference in elevation. On-site meteorological measurements at Nipple Bench began November 1, 1971 and at Fourmile Bench May 9, 1974 (Dames and Moore 1975). Mean annual temperature at Nipple Bench would be expected to be 3°F higher. From limited measurements available, Fourmile Bench has much lower temperatures than Nipple Bench. Whereas 0°F temperatures are rare at Nipple Bench, during the first winter operation at Fourmile a December low of 15° F. was recorded.

Annual average rainfall at Nipple Bench would be expected to average seven to eight inches, slightly lower than Fourmile Bench. Three years of measurements at Nipple Bench have averaged 4.23 inches per year. Potential evapotranspiration is greater at Nipple Bench averaging 30 to 33 inches and the number of frost free days, representing the growing season, slightly longer averaging 160 days per year. Differences in surface winds between the two sites are minor. Prevailing winds are westerly and west-southwesterly at Fourmile Bench. The annual velocity at Nipple Bench is slightly higher. There was no evidence of channeling or drainage wind flows

which would cause effluents to frequently flow in a single direction.

Upper winds which would influence the plume have a similar flow pattern for both Nipple Bench and Fourmile Bench, predominantly from the southwest and west toward the northeast and east with an average wind speed of 11 mph (Dames and Moore 1973, Spangler et al. 1973, Spangler et al. 1974).

Atmospheric stability structure measurements of the lowest 3,000 feet above Nipple Bench in January, February, October and December 1971 (Dames and Moore 1973) indicated neutral conditions 40 percent of the time and stable conditions 60 percent of the time with a small probability of unstable air within the depth. Meteorological and plume tracer studies at Nipple Bench in November 1973 (Spangler et al. 1974) indicated a predominance of moderately stable to very stable conditions from the surface to 1,100 feet and neutral to slightly stable conditions within the calculated plume elevation during morning (0730) measurements. Afternoon measurements indicated a predominance of neutral conditions from surface to 1,100 feet and neutral stability conditions within the expected plume evironment. Very stable atmospheric conditions are expected to occur infrequently at both sites. Observations suggest that turbulence, which would enhance plume dispersion was consistently lighter at Nippler Bench than at Fourmile Bench (Spangler et al. 1974). Data collected thus far indicate a greater frequency of norming surface based inversions at Nipple Bench compared with Fourmile Bench.

Stagnation conditions, which include a prolonged limited mixing condition and low wind speeds, are expected to occur with a slightly greater frequency at Nipple Bench than at Fourmile Bench. Frequency of occurrence of such conditions is expected to be seven to eight times per five years at Nipple Bench and four to five times per five years at Fourmile Bench. Expected duration length at both locations would be five to seven years.

Geology and topography

The Nipple Bench area is flat and gently slopes to the southeast. Average

elevation is 5,100 feet above mean sea level. Geology of the area is primarily the Straight Cliffs formation, underlain by Tropic shale and Dakota sandstone formations. There are no known coal beds or other minerals underlying Nipple Bench.

Soils

Soils found on Nipple Bench belong to the Badland-Rockland soil association. These soils are moderately-coarse textured varying from shallow to moderately deep (24 to 30 inches). Erosion susceptibility is moderate with an estimated average annual sediment yield of 0.45 acre-feet per square mile. These soils have an infiltration rate of 2.0 to 3.5 inches per hour. Soils found on Nipple Bench could be successfully seeded three to five years out of ten because of marginal annual rainfall.

Water resources

Only known perennial sources of water on Nipple Bench are Tibbet Spring and Nipple Spring. These springs are considered fresh to slightly saline in quality as they contain 500 to 3.00 milligrams of salts per liter. Water yield is less than 10 gallons /per minute for both of these springs. The only known underground aquifer on Nipple Bench is the Navajo sandstone formation, which lies two to four thousand feet below the surface.

Vegetation

Dominant vegetation on Nipple Bench is blackbrush, whose roots penetrate the soil an average 11 inches on this site. Fifty-one percent of the area is bare ground, 23 percent covered by vegetation, two percent by liter and the remaining 24 percent consists of rock less than two inches in diameter.

Wildlife

Wildlife onf Nipple Bench consists primarily of small mammals, songbirds and birds of prey.

Ecological interrelationships

Although there are two perennial sources of water on Nipple Bench, vegetation available will not support big game animals. Vegetation is sparse because of the high evapotranspiration rate and low water holding capacity of soils, coupled with low productivity of the site. The only wildlife that can survive on Nipple Bench are small mammals and songbirds. Because of the open nature of vegetation, birds of prey find Nipple Bench an ideal hunting ground for small mammals.

On the Nipple Spring side of Nipple Bench all runoff flows into Wahweap Drainage. The remainder of Nipple Bench drains into Warm Creek Drainage.

Paleontological, archaeological and historical

Nipple Bench exhibits fewer fossils than does Fourmile Bench. Fifty sites of archaeological significance have been found on Nipple Bench, but there are no known sites of historical value on the same area.

Recreation

See Recreation Resources in Chapter II under Kaiparowits Plateau Impact area.

Land uses

Livestock

Nipple Bench contains one livestock grazing allotment - 948 AUMs for one livestock operator.

Recreation

There is some hunting and sightseeing of a very limited nature.

Mineral

There are no minable coal deposits underlying Nipple Bench, nor is there any other mineral activity taking place.

Wood products

There are no commercial wood products on Nipple Bench.

Agriculture

There are no agricultural lands on Nipple Bench.

Transportation facilities

Nipple Bench has sparsely scattered truck and stock trails traversing the area. However, there are no improved access roads to or on Nipple Bench.

Transmission facilities

Nipple Bench to Eldorado alternate route

Few, if any, significant differences would exist with regard to natural or human resources as discussed for the proposed Fourmile Bench site. Nipple Bench is in a zone of slightly lower rainfall than Fourmile Bench, but data are lacking from which to determine differences in impacts on air quality or revegetation potential for transmission lines from the two sites.

The first five miles of this route would fllow the same alignment as the first five miles of the proposed Wahweap alternate of the Kaiparowits-Moenkopi route beginning at the Nipple Bench site.

Alternate route from Nipple Bench to Navajo Generating Station, Westwing Station and Mohave Generating Station

Description of the environment for the Nipple Bench to Eldorado proposed route also applies to the first mile of this alternate route. Description of the environment for the John Henry alternate applies to the remainder of this proposed route.

Ty Hatch alternate

The Ty Hatch alternate crosses the same type of terrain as the proposed

Fourmile Bench site transmission line, and the environment would be essentially the same.

Wahweap alternate

Descriptions of the environment for the first five miles of the proposed Nipple Bench to Eldorado route and the proposed routes from Fourmile Bench apply to the Wahweap alternate.

Environmental impacts

Generating plant facilities

Air Quality

Studies were conducted to evaluate the impact on air quality of placing the plant at the Nipple Bench site. These studies included meteorology and diffusion climatology (Dames and Moore, 1973), oil smoke tracer releases (Spangler et al., 1973), dispersion climatology, oil smoke, and fluorescent particle tracer studies (Spangler et al., 1974), visibility study (Bechtel 1974), plume opacity study (Radian 1974), cooling tower drift and fogging study (Bechtel 1974), and a salt deposition study (Meteorology Research, Inc., 1974).

The Dames and Moore study (1973) stated the following:

1. No adverse meteorological condition (destructive winds, extreme temperatures, or damaging precipitation) is probable at the Nipple Bench site.

2. The site is free of surrounding terrain obstacles that could cause channeling of wind or aerodynamic effects on the station's stack effluents.

3. The site is well ventilated with an average wind speed at stack height (700 feet) of at least five mps (11 mph).

4. Although stable conditions are common in this region (approximately 60 percent of the time) this will usually serve to prevent the plants effluent from reaching the ground in significant concentrations.

The North American Weather Consultants' oil-fog plume simulation study Fourmile Bench, Nipple Bench, Horse Flat, Dry Bench and John Henry Bench (Spangler et al., 1973) stated:

> "Although the thermal structure of the atmosphere did not change significantly between sites, visual observation of the smoke released over each site under various meteorological conditions often demonstrated significant variations in plume dispersion characteristics and terrain effects. The observations clearly show that Fourmile Bench and Horse Flat have minim m potential for elevated terrain effects upon plume dispersion. Even at Nipple Bench, the smoke was observed to descend sharply when leaving the plateau and later fumigate around the elevated terrain to the northwest".

The study further stated: "In summary, the visual and quantitative measurements of the smoke tracer plumes strongly suggest that the most favorable plume transport and dispersion characteristics are found on Fourmile Bench and Horse Flat".

The North American Weather Consultants' study in 1973 (Spangler et al., 1974) indicated the following:

> "In general, neither site (Nipple and Fourmile Bench) has revealed any situation that would lead to a significant impact of SO_2 upon surrounding terrain. The plume transport and diffusion, however, would be different for these sites and the influence of the surrounding terrain would be another factor to consider. Examining the potential impact in more detail, it was found in both November 1973 and May 1974 field data that whenever Fourmile Bench stable plumes were transported towards the northeast, they cleared the elevated terrain. The plumes were observed to follow the terrain rather than fumigate or impact upon it. The terrain in the immediate vicinity of the site is well below plume altitude and quite rugged, lead ıg to enhanced dispersion. However, the plume dispersion patterns observed at Nipple Bench included transport towards the elevated terrain within 6-10 km (4-6 miles) to the northwest. When oil fog plumes were released in the vicinity of these cliffs during the November 1973 program (Spangler et al., 1973) the plumes were drawn toward the cliffs and several fumigated onto the terrain. A release over Nipple Bench in November 1973 traveled northwest toward the cliffs and mixed to near the terrain in the vicinity of Jack Riggs Bench. This type of dispersion condition requires southeasterly flow and stable air mass which, climatologically, is a very infrequent condition at Nipple Bench. In summary, the field programs conducted for the Kaiparowits project have not revealed quantitatively any significant impact upon surrounding terrain".

Oil fog and plume tracer studies were conducted under conditions of unstable, neutral, and slightly stable atmospheric conditions. Stable, limited mixing, and inversion breakup conditions were examined utilizing the Intercomp Model (Intera 1974). The results are shown in Figure 11. The unstable case is most like those conditions observed during tracer studies. Results in Figure 11 are consistent with the concentration found during the tracer tests (Intera 1974).

Highest ground level concentrations are predicted for the inversion breakup or fumigation condition. The calculated one-hour concentration would be

FIGURE 11

Predictions of Sulfur Dioxide Ground-level Concentrations
Under Varying Meteorological Conditions at Nipple Bench

Meteorological Condition	Calculated Concentration* (ug/m^3)	Calculated Equivalent 3-hr Concentration (ug/m^3)	Location	Elevation (meters)	Distance (Kilometers)	Wind Direction (degrees)	Wind Speed (m/sec.
Stable	27	20	Kaiparowits Plateau South end	2310	25	248	3
Stability Class E	49	37	Fourmile Bench	1800	15	148	3
Plume Elev. 2103m	41	31	Smoky Mt.	1700	16	260	3
Unstable	60	45	Nipple Bench		2.3	135	5
Stability Class B							
Plume Elev. 2204m							
Limited Mixing	128	96	Nipple Bench		2.3	135	5
Stability Class							
B-Mixed layer							
E-Inversion layer							
Plume Elev. 2204m							
Inversion base 520m							
Inversion Breakup							
Stability Class							
B-Mixed layer							
F-Inversion	240	171	Nipple Bench		2.1	135	5
Plume Elev. 2103m							
Inversion Base 550m							
E-Inversion	212		Nipple Bench		2.3	135	5

* One-hour averaging time

Source strength 565 gm/sec

240 ug/m^3 and the equivalent three-hour concentration would be 171 ug/m^3. Corresponding calculated maximum ground level concentrations of particulates, sulfur dioxide, and nitrogen oxides and comparison with applicable standards is shown in Figure 12. Calculated levels do not differ significantly from predicted levels for Fourmile Bench. Levels would be within limitation of National Ambient Air Quality standards and Class II limitations of Significant Deterioration regulations. No adverse impacts would be expected on human health and welfare.

The Nipple Bench site would be located in close proximity to designated boundaries of several national parks, recreation areas and forests. These areas have potential for designation as areas in which any deterioration in air quality would be considered significant (Class I). If any one of these areas were to be redesignated as Class I, it would have to be determined if emissions from the Nipple Bench site would significantly affect the air quality of the redesignated area.

The estimates of impacts on visibility do not differ significantly with Fourmile Bench as shown in Illustrations 27 and 28.

Cooling tower plume impacts from moisture effects, salt dispersal, and fogging potential are not expected to be significantly different than Fourmile Bench. The aesthetic impact of the cooling tower plume would be greater at Nipple Bench because it would be closer to Lake Powell Basin.

The Nipple Bench site is approximately 1,000 feet lower in elevation than Fourmile Bench and about 15 miles closer to Navajo Power Plant. Stagnation episodes and confinement of emissions would occur slightly more frequently at Nipple Bench than at Fourmile Bench. Based on available data, although air quality would be affected during stagnation conditions present airquality standards would not be exceeded.

Since Nipple Bench would be closer to the Navajo Plant than Fourmile Bench, the potential for plume interaction would be greater. Available meteorological data indicate that even at Nipple Bench, necessary meteorological conditions for plume interaction occur with low frequency, about 10 percent of the time.

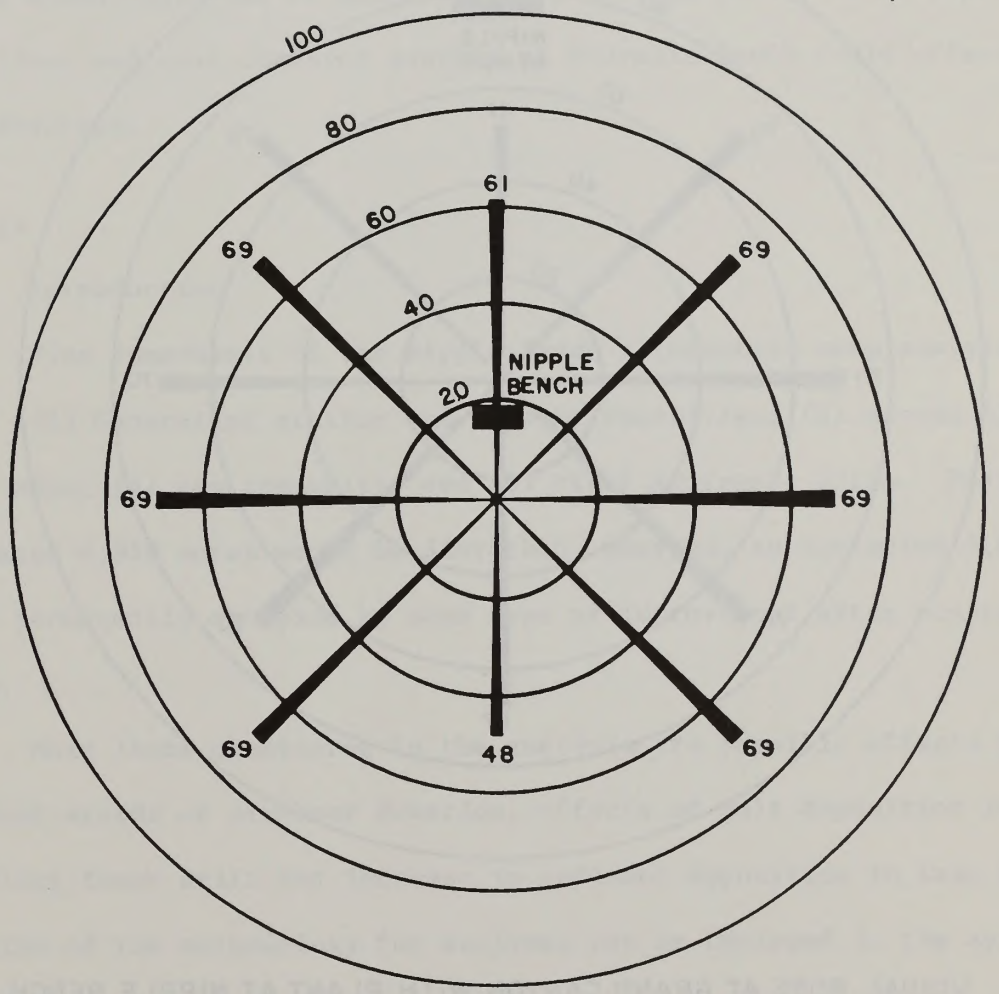
FIGURE 12

Comparison of Air Quality Standards
With Calculated Ground-level Concentrations[a]

Kaiparowits Project - Nipple Bench
(ug/m^3 (ppm)

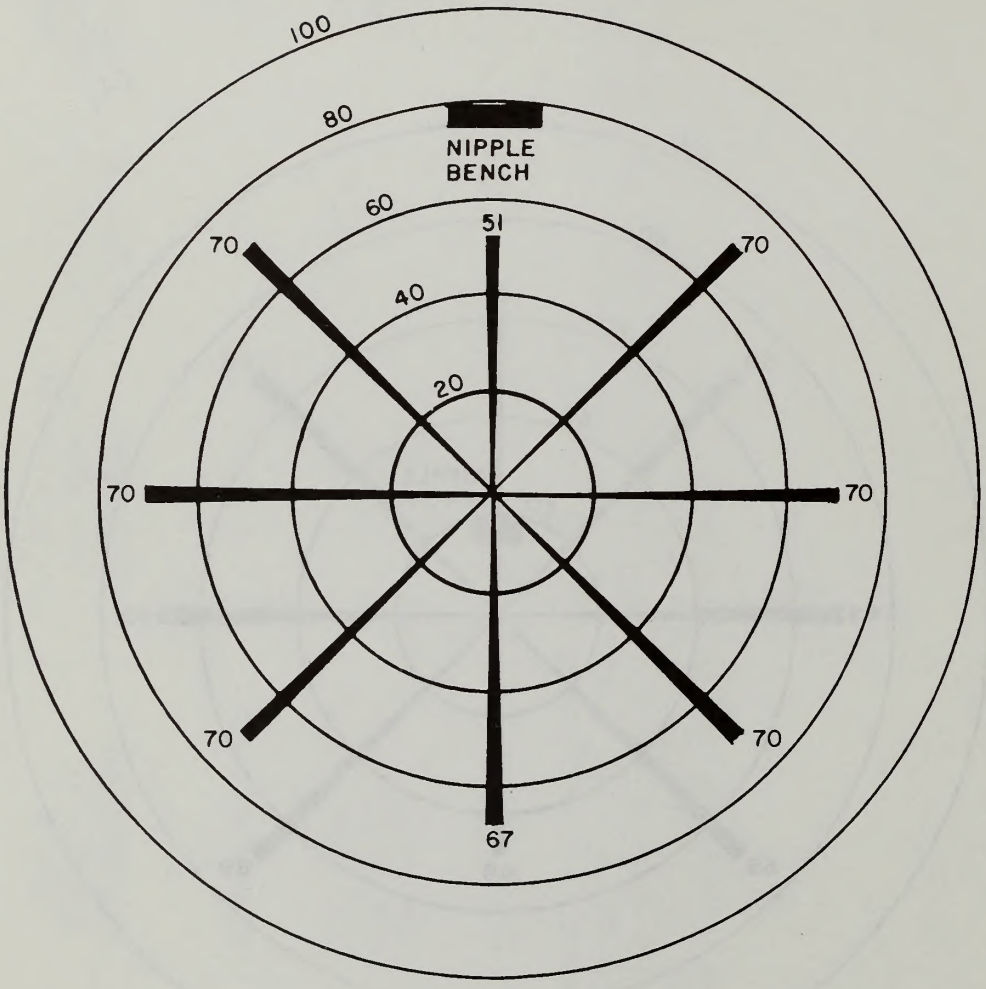
Emission	Maximum Calculated Ground-level Concentration[b]	Natural Background Concentration	Most Restrictive Air Quality Standard[c]	Percent of Standard	Ambient Air Quality Standard	Percent of Standard
Particulates						
Annual	1	30	10	10	60	52
24-hour	10	Highly variable	30	33	100	10
Sulfur Dioxide						
Annual	3 (0.001)	Negligible	15	20	50 (0.02)	6
24-hour	42 (0.018)	Negligible	100	42	260 (0.10)	16
3-hour	171 (0.071)	Negligible	700	24	1300 (0.50)	13
Nitrogen Dioxide[d]						
Annual	15 (0.008)	Negligible			100 (0.05)	23

a Calculations based on predictive plume dispersion model "Intercomp"
b The maximum concentrations are expected to occur at a downwind distance of 2,300 meters
c Based on an area designation of Class II under federal regulation for prevention of significant air quality deterioration
d Assumes all nitrogen oxides converted to nitrogen diosice



VISUAL ROSE AT PAGE, ARIZONA, WITH PLANT AT NIPPLE BENCH AND 70 MILE BACKGROUND VISUAL RANGE. FREQUENCY OF OCCURRENCE WILL BE LESS THAN 5%.

ILLUSTRATION 27



VISUAL ROSE AT GRAND CANYON WITH PLANT AT NIPPLE BENCH AND 70 MILE BACKGROUND VISUAL RANGE. FREQUENCY OF OCCURRENCE WILL BE LESS THAN 5%.

ILLUSTRATION 28

Impacts on air quality resulting from mining operations would not be significantly different between Nipple Bench and Fourmile Bench.

Fugitive dust from access roads, construction, etc., could be greater at Nipple Bench than at Fourmile Bench. Nipple Bench has a greater potential for suspension and redistribution of soil particles due to sparse vegetative cover and greater wind exposure from lack of overstory vegetation. However, the greater amount of disturbance due to added length of access roads, water pipeline, transmission lines and coal conveyor systems at Fourmile Bench could offset this apparent advantage.

Soils

Introduction

Five components of the Nipple Bench alternative were analyzed for impacts: (1) Generating station and support facilities; (2) access highways; (3) coal mine; (4) new community; and (5) other aggregate sites. During construction an estimated 8,950 acres would be disturbed, whereas, an estimated 5,850 acres would be permanently occupied by some type of improvement after construction is complete.

Main items considered in the analysis are possible effects of two-year and 50-year storms of six-hour duration, effects of salt deposition in soils from cooling tower drift and increase in sediment deposition in Lake Powell. A description of the methodology for analyses can be reviewed in the appendix to Chapter III.

Power plant

During construction phase of the power plant facilities, 1,385 acres or 2.2 square miles would be disturbed. After construction is completed, 1,075 acres or 1.7 square miles would be permanently occupied by some type of structure, pond, disposal site or road.

During construction phase, runoff from a two-year, six-hour storm would be increased by 9.57 acre-feet, and decreased 2.25 acre-feet after construction due to the presence of water impoundment areas of relatively impervious surface. However, 185 acres of impervious surface would contribute 7.32 acre-feet more than present estimated runoff. During a 50-year, six-hour storm, runoff would be increased by 26.4 acre-feet during construction and decreased 31.2 acre-feet after construction. Reason for the net decrease of 4.8 acre-feet after construction under the 50-year storm conditions is that pond sites would not contribute runoff after construction is completed. Estimated annual sediment would be increased by 0.28 acre-feet during construction and decreased 0.54 acre-feet after construction is completed. Net decrease of 0.26 acre-feet would be due to impervious surfaces and pond areas. Runoff and sediment would flow into Warm Creek Drainage.

Impacts caused by the fly ash-scrubber residue disposal site on Nipple Bench would be the same as those impacts described in Chapter III for the Fourmile Bench site. However, it would take only three to four years for side slopes to erode and a total of approximately 40 acre-feet of sediment would flow directly into Tippets Canyon.

Deposition of salt entrained in drift from cooling towers varies from 0.5 pounds per acre per year to 250 pounds per acre per year depending on distance from cooling towers. After 50 years have elapsed, salt accumulation in soil would affect approximately 865 acres of vegetation. At that time annual sediment production on the impacted area estimated to be 0.08 acre-foot greater than present estimated sediment production. Vegetative cover would be reduced an average 50 percent on salt accumulation acres. Sodium absorption ratio (SAR) for salt deposited in soil is 2.42 not considered detrimental to vegetative growth from a sodium hazard standpoint.

Actual deposition of salt on foilage could possibly be detrimental to vegetation. However, it is not known at this time whether defoliation would occur or growth would be inhibited.

Effects of trace elements on the soils on Nipple Bench would be the same as on Fourmile Bench - of no consequence.

Sediment and runoff would flow into either Tibbets Canyon or Nipple Creek. Probability of seeding success would be three to five years out of ten years.

Water pipeline

During construction phase of the water pipeline, 325 acres or 0.50 square mile would be disturbed. After construction is completed, 120 acres or 0.19 square mile would be occupied by pipeline, access roads, patrol roads, conveyor systems and power lines.

During construction, estimated runoff from a two-year, six-hour storm would be increased by 1.4 acre-feet and increased another 0.8 acre-foot after construction this is 2.2 acre-feet higher than present estimates. This increase would be due to the packed surface of patrol roads.

During a 50-year, six-hour storm, estimated runoff would be increased 4.4 acre-feet during construction and increased another 2.3 acre-feet after construction is completed, this is 6.7 acre-feet higher than present estimates.

Estimated annual sediment yield would be increased by 0.03 acre-foot during construction and decreased 0.01 acre-foot after construction which is still 0.02 acre-foot higher than present annual sediment estimates. Initial reduction in sediment would be due to restoration of disturbed areas. However, the additional 0.02 acre-foot of sediment occurring after construction would be due to water movement down slopes and barrow areas as yielded from road surfaces. Runoff and sediment from pipeline construction would flow into Warm Creek Drainage, whereas runoff and sediment from the access road would flow into Wahweap Creek Drainage.

Runoff from a 50-year, six-hour storm would be increased by 0.4 acre-foot during construction and increased another 0.3 acre-foot after construction

is completed. Runoff after construction would be 0.7 acre-foot greater than present estimates. As in the case of the two-hour storm, at least half the net increase in runoff would occur in sagebrush areas.

Estimated annual sediment yield would be increased by 0.006 acre-foot during construction and decreased 0.003 acre-foot after construction is complete. Estimated annual sediment yield after construction would be 0.003 acre-foot greater than present estimates. The majority of sediment increase would occur along barrow areas within sagebrush stands. All runoff and sediment production would flow into Wahweap Creek.

Aggregate sites and access road

An existing jeep trail would have to be reconstructed for access into the proposed aggregate site on upper Wahweap Creek. The aggregate pit would be confined to the creek bed and would not affect runoff and erosion. Open pits in the creek bed would act as settling basins whenever a storm occurs.

After a few storms, all traces of aggregate pits would be obliterated. As long as no channel straightening occurs, there would not be any damage to the down-stream channel or Lake Powell. However, should channel straightening take place Wahweap Creek would erode back towards the upper reaches of the drainage system resulting in sediment deposition in lower portions of Wahweap Creek and Lake Powell. Time involved and amount of damage that would take place cannot be evaluated because of complexity of the drainage system and inconsistency of storm patterns.

The access road to the aggregate pit would require disturbance of 15 acres or 0.023 square miles. After construction is completed 10 acres or 0.016 square miles would be occupied by road surface and barrow areas.

During construction, runoff from a two-year, six-hour storm would be increased by 0.04 acre-foot and increased another 0.18 acre-foot after construction.

Runoff after construction would be 0.22 acre-foot greater than present estimates. At least half of the net increase in runoff would occur in sagebrush areas.

Runoff from a 50-year, six-hour storm would be increased by 0.4 acre-foot during construction and increased another 0.3 acre-foot after construction is completed. Runoff after construction would be 0.7 acre-foot greater than present estimates. As with the two-hour storm, at least half of the net increase in runoff would occur in sagebrush areas.

Estimated annual sediment yield would be increased by 0.006 acre-foot during construction and decreased 0.003 acre-foot after construction is complete. Estimated annual sediment yield after construction would be 0.003 acre-foot greater than present estimates. The majority of sediment yield increase would occur along barrow areas within sagebrush stands. All runoff and sediment production would flow into Wahweap Creek.

Access Highways

During construction of the highway, 430 acres or 0.67 square miles would be disturbed. After construction is complete, 300 acres or 0.47 square miles would be occupied by road surface and barrow areas.

During construction, runoff from a two-year, six-hour storm would increase by 3.0 acre-feet and increase another 0.5 acre-foot after construction. Runoff after construction is completed would be 3.5 acre-feet greater than present yield. Greatest amount of runoff would occur on that portion of highway to Nipple Creek and the segment crossing Wesses Canyon and Pilot Knob to the coal mine.

Runoff from a 50-year, six-hour storm would be increased by 5.6 acre-feet during construction and increased another 2.0 acre-feet after construction. Runoff after construction would be 7.6 acre-feet greater than present estimates. As in the case of the two-year, six-hour storm, greatest amount of runoff would occur along Nipple Creek, Pilot Knob and Wesses Canyon segments.

Estimated annual sediment yield would be increased by 0.06 acre-foot during construction and decreased 0.03 acre-foot after construction this is still 0.03 acre-foot higher than present annual sediment yield estimates. The additional 0.03 acre-foot of sediment occurring after construction would be due to water movement down slopes and barrow acres from road surfaces, particularly on Nipple Creek, Pilot Knob and Wesses Canyon segments. Runoff and sediment from Glen Canon City-Nipple Bench highway would flow into Wahweap Drainage. Majority of runoff and sediment from Nipple Spring to the training mine would flow into Warm Creek Drainage.

Nipple Creek, Pilot Knob and Wesses Canyon segments are most sensitive to erosion and runoff because of moderately steep slopes with shallow and fragile soils.

Impact to the Paria River Drainage would be the same as that described in the Fourmile Bench proposal impacts.

Coal Mine

During construction of coal mine facilities, 1,910 acres or 3.0 square miles would be disturbed. After construction is complete, 1,710 acres or 2.7 square miles would be permanently occupied by roads, buildings, ponds, refuse dumps, mine portals, and conveyors.

During construction, runoff from a two-year, six-hour storm would increase by 2.6 acre-feet, and increase an additional 13.4 acre-feet after construction is completed. Total increase in runoff would be 16 acre-feet compared to present runoff estimates. This increase would be caused by impervious surfaces on buildings, roads, and protective structures.

Runoff from a 50-year, six-hour storm would be increased by 22.6 acre-feet during construction and increased another 5.2 acre-feet after construction. Total increase in runoff for a 50-year, six-hour storm would be 27.8 acre-feet when compared to present estimates. Increased runoff would be caused by impervious

surfaces on buildings, roads, and protective structures.

Estimated annual sediment yield would be increased by 0.3 acre-foot during construction and decreased 1.2 acre-feet after construction. Net decrease in sediment yield when compared to the present estimate would be 0.9 acre-foot. However, this is misleading as the road down Missing Canyon to the training mine would have an increase in sediment yield after construction is completed due to increased runoff and sloping barrow areas. Missing Canyon also has a history of flash floods that move large amounts of soil material. Impervious areas account for the net decrease in sediment production. All runoff and sediment would flow into Warm Creek Drainage.

New community

During the construction phase, 4,480 acres would be disturbed, of which approximately 50 percent would be permanently occupied after construction by impervious surfaces in the form of streets, sidewalks, driveways, rooftops and patios.

During construction, the maximum runoff from a two-year, six-hour storm would be increased by 4.5 acre-feet and increase an additional 26.3 to 46.8 acre-feet after construction is complete. The total increase would be caused by impervious surfaces associated with the new community.

Runoff from a 50-year, six-hour storm would be increased 95.0 acre-feet during construction and increased an additional 52.5 to 97.3 acre-feet after construction is completed. Total increase in runoff would be 147.5 to 192.3 acre-feet when compared to present estimates. The total increase would be caused by impervious surfaces associated with the new community.

Estimated annual sediment yield would be increased by 1.0 acre-feet during construction and decreased 0.5 acre-foot after construction is completed. Net increase in annual sediment production following construction would be 0.5 acre-foot. Decrease in sediment production from construction phase to completion

phase would be attributable to impervious surfaces, which would have a tendency to stabilize soil surface. However, net increase in annual sediment yield after construction would take place in natural drainages where runoff water would flow into Wahweap Creek.

Water that would be used by the new community to irrigate landscaping is not considered detrimental to soil. Electrical conductivity of the water is 477 micromhos (477×10^6), indicating a low to medium salinity (soluble salts) hazard. The sodium absorption ratio (SAR) for the water was determined at 3.1, which indicates a low alkali (exhangeable sodium) hazard (Richards, 1954). Indicated hazards are too low to inhibit growth of native vegetation or any introduced species.

Soil suitability for septic tank fields, sewage lagoons, sanitary landfill, dwellings, roads and streets would be the same as described in Chapter III for the Fourmile Bench proposal.

Summary of impacts

Individual effects of runoff and sediment production were identified earlier in this section. However, possible cumulative effects of runoff and sediment on various drainages and Lake Powell, should be discussed.

For a 50-year, six-hour duration storm, during construction, runoff would be an additional 110 percent of normal. After construction is complete, runoff would be an additional 45 to 77 percent of normal because of large areas of impervious surfaces. However, on 865 acres affected by salt accumulation from cooling tower drift, additional runoff water could be expected to flow into Warm Creek. If the 50-year storm occurred after 50 years have elapsed, potential runoff would be 50 percent greater than present estimates.

Runoff from the salt accumulation area for a two-year, six-hour duration storm would be significantly increased after 50 years have elapsed. Runoff would increase 33 percent since ground cover would have decreased 25 percent.

Runoff in Warm Creek Drainage would be increased 1.4 percent during construction and 2.5 percent after construction. Runoff in Wahweap Drainage would increase 0.4 percent during construction and 1.8 to 2.8 percent after construction. Total increased runoff into Lake Powell would be 0.7 percent during construction and 2.0 to 2.7 percent after construction. Increased runoff is attributed to access roads and impervious surfaces. Note in each case the increased quantities of runoff into Wahweap Creek, Warm Creek and Lake Powell are less than three percent and, therefore, would not have a significant impact, either adverse or favorable.

During construction, sediment yield would increase 29 percent and decrease eight percent after construction is complete. However, this is misleading as the barrow areas along roads, which receive increased amounts of runoff, would be eroding at a faster rate than the present situation, particularly along the access road to the training mine in Missing Canyon and the highway along Nipple Creek, Pilot Knob and Wesses Canyon. After 50 years have lapsed, annual sediment yield from the plant site including the salt accumulation area would still be 80 percent of present estimates.

During construction, annual sediment yield would be increased 0.5 percent in Warm Creek Drainage, 0.4 percent in Wahweap Creek Drainage and 0.5 percent in Lake Powell. The increase for Lake Powell assumes that all other variables in other portions of the lake would remain constant. After construction is complete, sediment load in Warm Creek Drainage would decrease 0.90 percent, increase 0.2 percent in Wahweap Creek Drainage, with a net decrease in Lake Powell of 0.1 percent. These results do not reflect localized problems along access roads and highways. Increased sediment yields are less than one percent and therefore not significant.

With the exception of Wahweap Creek Drainage, there would be a net decrease of 12.9 acre-feet in accumulative sediment deposition in Warm Creek and Lake Powell over a 50-year period. However, this decrease does not reflect localized problems of highways and roads along Pilot Knob and Wesses and Missing Canyons. Increased

sediment in Wahweap Creek, would be attributed to the new community on East Clark Bench, the new highway along Nipple Creek and the proposed access road to the aggregate site.

It is not known if reduction of sediment depostion in Lake Powell would result in a reduction of nutrients for phytoplankton and phyloplankton, which in turn are a source of food for fish and other aquatic species. Reduction of sediment would definitely benefit spawning habitat.

The above analysis assumes there would be no subsidence in the coal mine area, nor channel straightening during extraction of aggregates in upper Wahweap Creek and that drift rate for salt entrained in water from cooling towers would be 0.01 percent.

If subsidence did occur in the coal mine area, estimated storm runoff and sediment yield would be reduced proportionally to the area subsiding. This would result in further sediment reduction in Warm Creek Drainage.

If the drift rate from cooling towers were reduced by two to ten times, sediment from surface disturbance would increase during construction of additional evaporation ponds. This would result in a net decrease in storm runoff and sediment yield in Warm Creek Drainage after construction has been completed. Also, effects of salts on soils and vegetation would become negligible, resulting in further decreases in storm runoff and sediment yield to Warm Creek and Lake Powell.

If channel straightening occurred along upper Wahweap Creek sediment deposition to the Wahweap arm of Lake Powell could be increased two to ten times over a multi-year period with the annual rate accelerating as each year passes.

If new community was established and the power plant built, additional deterioration to Warm Creek, Wahweap Creek and Last Chance drainages would occur. This deterioration would be from recreation and off-road vehicles traversing the area and compacting soils, thus depleting vegetative cover and increasing the annual rate of sediment deposition in Lake Powell. As indicated in the previous

analysis, initial sediment deposition would occur in the Warm and Wahweap Creek drainages. However, if the new community and power plant are established, then sediment deposition would occur in Last Chance Creek Drainage. Because of the possible larger areas that would be affected by recreational activities, sediment deposition in Lake Powell from all three drainages would exceed those estimates for the construction phase. However, because of lack of knowledge on which areas would be affected, it is impossible to quantify potential impact.

Water resources

Disturbance and occupation of Nipple Bench would result in greater amounts of runoff water and less sediment yield when compared to Fourmile Bench.

Reduction in length of the water pipeline and access highways would reduce sediment and runoff accordingly. The coal mine, new community, and aggregate access road impacts to water quality and sediment deposition in Lake Powell, would be negligible.

There is a possibility that leakage from evaporation ponds would reach Lake Powell more readily; however, this impact cannot be properly evaluated at this time. There is also possibility that water flow from Tibbett and Nipple springs could be disrupted during the construction phase. Extent or possibility of this disruption is not known at this time.

Vegetation

During construction, 8,950 acres would be disturbed and 5,850 acres would be occupied by some type of improvement after construction of the power plant, water pipeline, access highway, new community, coal mine, aggregate sites and access roads. The Nipple Bench proposal would disturb 1,385 acres, which is 215 acres more than the Fourmile Bench proposal, and would occupy 1,075 acres after construction is completed, which is 145 acres more than the Fourmile Bench proposal.

Stack emissions would have a negligible effect on vegetation, whereas salt accumulation resulting from cooling tower drift could reduce vegetative cover in

the salt drift area by as much as 50 percent.

Wildlife

The only wildlife that would be adversely affected by the Nipple Bench proposal would be small mammals and songbirds, particularly during construction. Hunting grounds for birds of prey would be disrupted. However, this disruption is considered minimal as most small mammals would return after construction is completed.

Ecological interrelationships

The measureable adverse effect on ecological interrelationships would be that 865 acres subjected to salt accumulation from cooling tower drift. Based on present drift rate estimates, vegetative cover would be reduced by 50 percent.

Another disruption to ecological interrelationships would be the use of off-road and recreation vehicles in remote fragile areas. Most of this use could be attributed to residents from the new community. Annual erosion rates could increase at far greater rates than presently estimated for the construction phase. Presence of motorized vehicles in remote canyons could inhibit nesting and reproduction of birds of prey and might force deer herds into remote and inaccessible areas. Deterioration of vegetation and soils and impacts on wildlife by indiscrimate off-road vehicle use cannot be evaluated at this time.

Small mammals presently residing on Nipple Bench could be replaced by rats if the power plant was built there.

Socio-economic

Socio-economic impacts for the Nipple Bench alternative would be generally the same impacts as those described for the Fourmile Bench proposal. However, Nipple Bench would be closer to the New Town and there would be less consumption of gasoline by employees' automobiles used for transportation to and from work.

Geotechnical

Nipple Bench is not underlain by any known recoverable coal deposits nor known oil and gas deposits.

Recreation

Recreation impacts resulting from the Nipple Bench alternative would be basically the same as those described for the Fourmile Bench proposal. There would be lesser impacts to the aesthetics due to shorter pipelines and highways. Hunting and sightseeing that takes place on Nipple Bench would be lost to the public.

Paleontology

Limited surveys on Nipple Bench revealed three paleontological sites of some scientific value. Fragments of turtle shells and dinosaur bones are found and crocodile teeth and plant impressions occur within the Wahweap sandstone. Additional surveys must be undertaken.

Archaeology

Thirty-five archaeological sites occur. Fifteen scientifically important archaeological sites occur within the confines of the plant site area and twenty in the one-half mile buffer zone agreed upon for purposes of study and impact. Five of these sites would be directly affected by the proposed activities, i.e. plant facilities and disposal areas and the remainder by secondary impacts. A thorough intensive survey must be conducted with relocation of facilities where feasible and salvage considered where necessary.

Livestock

A grazing allotment consisting of 948 AUMs would be no longer available to one livestock operator.

Minerals

There would be no adverse impacts to minerals as there are no known mineral deposits on Nipple Bench.

Wood products

There are no wood products on Nipple Bench.

Agricultural lands

There are no agricultural lands on Nipple Bench.

Transportation

Access would be improved to Nipple Bench. However, access routes would not be available to the public.

Transmission facilities

Nipple Bench to Eldorado alternate

Environmental impacts of this proposed alternate route are the same as those discussed for the Fourmile site except there are no pinyon or juniper trees at the Nipple Bench site. Consequently, less clearing for the powerline will be required.

This route would be shorter than that from the Fourmile Bench site and has the advantage of being the most direct routing between the plant site and a tie-in with the proposed Fourmile Bench Transmission Line System, thereby minimizing transmission line and access road construction costs and environmental impacts on Nipple Bench and Wahweap Basin areas. Impacts on this alternate route would be the same as the East Clark Bench alternate, described in this chapter.

Alternate from Nipple Bench to Navajo Generating Station, Westwing Substation and Mohave Generating Station

This alternate route would cause the same environmental impacts as those discussed for the John Henry alternate and proposed routes from Fourmile Bench to

Navajo Generating Station, Westwing Substation, and Mohave Generating Station.

Ty Hatch alternate

The same access road problems exist with this route as with the proposed route where the route would descend the cliffs to Wahweap Basin. This route would be about three miles longer than the proposed route, and require six more angle towers. It does not have any significant terrain advantages over the Nipple Bench to Eldorado alternate route. In fact, crossing the Wahweap Basin would subject the line to more natural hazards of flooding and unstable tower footings than the more advantageous direct crossing followed by the proposed route. This route would, however, be a suitable alternate in the event the first five miles of the proposed route were utilized for the Kaiparowits-Moenkopi line.

Wahweap alternate

Impacts resulting from the Wahweap alternate would be the same as those from the proposed Nipple Bench to Eldorado route and proposed routes from Fourmile Bench.

Mitigation of environmental impacts and unavoidable adverse impacts

Generating plant facilities

Mitigating measures

See Chapter IV for discussion of mitigating measures.

Unavoidable adverse effects

The only adverse effect that cannot be avoided with the Nipple Bench alternative that is different from Fourmile Bench would be 865 acres that would receive salt deposition from cooling tower drift. This would be 510 acres less than the Fourmile Bench proposal. Because of salt drift, only 50 percent of vegetative cover would be removed from the Nipple Bench site compared to 70 percent on the Fourmile Bench site.

There would be a tendency for air stagnation to occur on Nipple Bench during downwash winds; this would not occur on Fourmile Bench.

Transmission facilities

Nipple Bench to Eldorado

Mitigating measures

Measures that would mitigate adverse impacts in this area are essentially the same as those for the Fourmile site. An additional measure that would be needed is that access to tower locations as far west as Mile 3 should be from the plant site. However, it appears that a through access road down the cliffs at Mile 3 is not advisable because of steep and unstable terrain which would make road construction and maintenance difficult and scarring would result. Access to tower locations west of the cliffs should be from the south, using access roads for the proposed Kaiparowits-Moenkopi Transmission Line System.

Unavoidable adverse effects

The unavoidable adverse effects related to this route are the same as those discussed for the Fourmile Bench site in Chapter III.

Alternate routes from Nipple Bench to Navajo Generating Station, Westwing Substation and Mohave Generating Station

Mitigating measures

Mitigating measures for the alternate route from Nipple Bench would be the same as mitigating measures for the John Henry alternate and the proposed routes from Fourmile Bench.

Unavoidable adverse effects

Unavoidable adverse effects resulting from the proposed route from Nipple Bench would be the same as those resulting from the John Henry alternate and proposed routes from Fourmile Bench.

Ty Hatch alternate

Mitigating measures

Same as those for the proposed action

Unavoidable adverse effects

Unavoidable adverse effects would be similar to those discussed in Nipple Bench to Eldorado alternate above.

Wahweap alternate

Mitigating measures

Mitigating measures for the Wahweap alternate would be the same as mitigating measures for the proposed Nipple Bench to Eldorado route and proposed routes from Fourmile Bench.

Unavoidable adverse effects

Unavoidable adverse effects resulting from the Wahweap alternate would be the same as those resulting from the proposed Nipple Bench to Eldorado route and proposed routes from Fourmile Bench.

FIGURE 13

Environmental Considerations

Factors	Fourmile Bench		Nipple Bench	
Average annual rainfall	8 to 9 inches		7 to 8 inches	
Frost-free days	150		160	
Potential evapo-transpiration	27 to 30 inches		30 to 33 inches	
Prevailing winds	From the southwest and west		From the southwest and west	
Elevation of plant site above mean sea level	6,200 feet		5,200 feet	
Stack height	600 feet		800 feet	
Stack emissions and rates	Similar for both sites			
Predicted ground level concentrations (Fumigation conditions)				
Particulates	ug/m^3	ppm	ug/m^3	ppm
Annual	1		1	
24-hour	11		10	
Sulfur dioxide				
Annual	2	0.009	3	0.0010
24-hour	46	0.0200	42	0.0180
3-hour	187	0.0830	171	0.0710
Nitrogen dioxide				
Annual	15	0.0080	15	0.0080
Stagnation episodes	2 to 3 episodes per year		slightly higher	
Average stagnation episode duration	5-7 days		5-7 days	
Predicted plume opacity	11%		13%	
Emission effects on visibility	Similar for both sites			

(continued)

FIGURE 13 (cont)

Factors	Fourmile Bench	Nipple Bench
Potential for plume entrapment by elevated inversion layer and ground level effects from limited mixing conditions	Slightly greater potential at Nipple Bench than Fourmile Bench	
Potential for plume interaction with elevated terrain	Greater potential at Nipple Bench than Fourmile Bench	
Cooling tower plume rise.	Similar for both sites	
Cooling tower fogging potential	Similar for both sites	
Drift rate from cooling towers	Similar for both sites	
Distance from Grand Canyon	76 miles	70 miles
Distance from Navajo Power Plant	36 miles	21 miles
Potential for plume interaction with Navajo Power Plant	Slightly greater at Nipple Bench, but low probability for both sites	
Total acres disturbed during construction	9,000	8,950
Total acres occupied by structures and improvements after construction completed.	5,800	5,850
Change in annual sediment deposition into Lake Powell as compared to present conditions:		
During construction	+ 1.9 Acre-feet	+ 1.7 acre-feet
After construction	- 0.5 acre-foot	- 0.5 acre-foot

(continued)

FIGURE 13 (cont)

Factors	Fourmile Bench	Nipple Bench
Potential number of acres that could be adversely affected by salt deposition from cooling tower drift	1,375	865
Potential percent reduction in vegetative cover	70 percent	50 percent
Change in cumulative sediment deposition in Lake Powell as compared to present conditions after 50 years have lapsed	- 26.00 acre-feet	- 12.9 acre-feet
Change in annual sediment yield on area of salt accumulation as compared to present conditions after 50 years have lapsed	+ 0.29 acre-foot	+ 0.08 acre-foot
Types and potential numbers of wildlife that could be lost due to presence of the power plant after 50 years have lapsed	20 head of deer year long or 70 head of deer during the winter and numerous small mammals, raptors, reptiles, birds and predators	Numerous small mammals, reptiles and a few birds
Loss of unique biological features	Pinyon and juniper trees of at least 500 to 700 years of age, one being in excess of 1,400 years of age.	Negligible
Impact on paleontological values	Encompasses the Kaiparowits formation that contains numerous fossils on 13 sites	Encompasses the Wahweap and Straight Cliffs sandstones that contain three sites with fossil fragments of turtle shells, dinosaur bones and crocodile teeth

(continued)

FIGURE 13 (cont)

Factors	Fourmile Bench	Nipple Bench
Impact on archaeological values	Contains 30 sites reflecting limited and specialized activities. Two of these sites would be disturbed by the proposed activities	Contains 35 sites exhibiting complex associations of features and artifacts. Five of these sites would be disturbed by the proposed activities
Effect on surface water quality	The effect would be the same regardless of the site chosen	
Effect on ground water quality	The effect would be the same for both sites as the ground water would be influenced by the mining operation on John Henry Bench and the new community on East Clark Bench	
Loss of livestock grazing (AUMs each year)	740	948
Visibility of power plant, indicating aesthetic impact on region	Power plant complex in full view from Bryce Canyon National Park, 32 miles away. Top of stack visible from Page, Arizona, 32.5 miles away. None of power plant complex visible from Glen Canyon City, Utah or Warm Creek Basin and Wahweap Marina on Lake Powell.	Top of stack visible from Bryce Canyon National Park, 40 miles away; Page, Arizona, 19 miles away; and 10 miles away on Highway U-89. Top of stack may also be visible from some portions of Lake Powell. None of power plant complex visible from Glen Canyon City, Utah, or Warm Creek Basin and Wahweap Marina on Lake Powell.
Total tons of coal underlying power plant site that would be lost during life of project	92 million	Negligible
Potential loss of wood products due to location of power plant	1,170 acres of trees suitable for firewood and posts.	None

(continued)

FIGURE 13 (continued)

Factors	Fourmile Bench	Nipple Bench
Potential impact on agricultural lands	There are no lands of agricultural value on Fourmile Bench or Nipple Bench.	
Mile of highway needed for access	67	71
Miles of access road needed for pipeline and power plant	60	45
Miles of water pipeline needed	32	19
Change in elevation from coal mine to power plant site	+ 1,200 feet	+ 200 feet
Miles of conveyor belt needed	13	14
Miles of rock tunnels needed	0.6	1.2
Miles of transmission lines that would be built	1,457	1,443

OTHER ALTERNATIVE GENERATING STATION SITES - KAIPAROWITS PLATEAU

From 1964 to 1973, Southern California Edison and Arizona Public Service companies examined 19 potential generating sites in Utah and Arizona (Illustration 29). In conducting siting studies, the companies considered technological, economic, and ecological factors. Distance that coal and water would have to be conveyed to any site was of major concern. An attempt was made to exclude consideration of any site within six miles of Bryce Canyon National Park, Capitol Reef National Park, Devil's Garden Outstanding Natural Area, Escalante Outstanding Natural Area, Glen Canyon National Recreation Area, and Dixie National Forest. Site studies also avoided coal lease areas.

Once potential areas were defined, air quality and line-of-sight profiles from critical locations to the power plant were major criteria for selection. Field reconnaissance, preliminary engineering studies, and order of magnitude cost estimates were included in the feasibility studies. The company task force presented a report July 28, 1964, which recommended consideration of four sites relatively close to Lake Powell. Subsequent discussions with the National Park Service, passage of the Clean Air Act in 1970, and meteorological studies of selected sites prompted the companies to consider sites on the nearby benches as alternatives. Nipple Bench was chosen as more favorable than lower sites because of reduced visibility from Page, Wahweap Marina, and Lake Powell, and more favorable conditions for dispersion of stack emissions. Environmental monitoring and related studies were initiated in preparation for an environmental report.

In June 1973, after discussions with members of his staff and others, the Secretary of the Interior denied, in principle, the applications that had been submitted for the proposed Kaiparowits generating station, primarily for environmental reasons. These environmental concerns included proximity of the plant site to the Glen Canyon National Recreation Area and Lake Powell, and proximity of the proposed power plant site to the Navajo power plant site under construction near Page, Arizona.

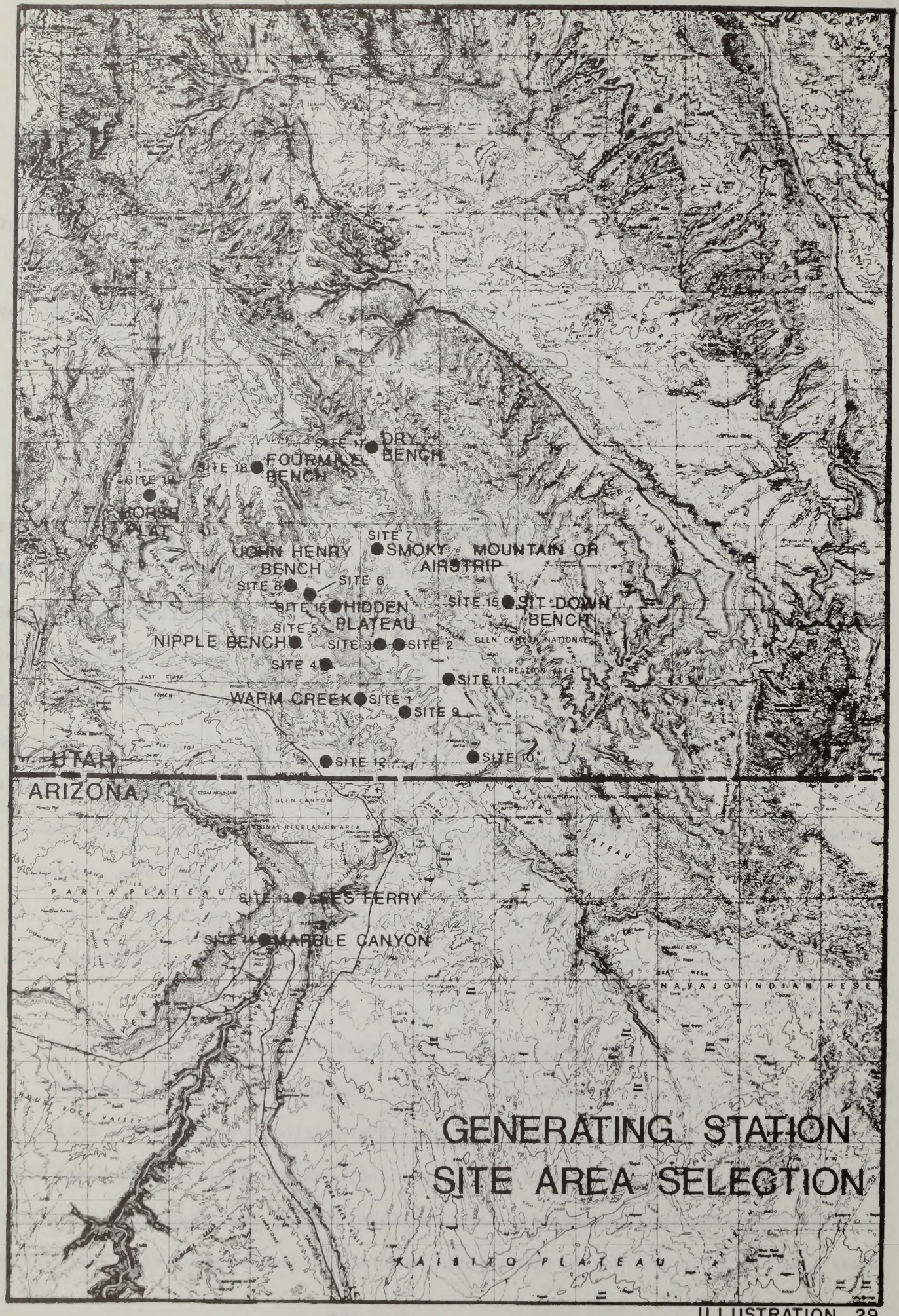


ILLUSTRATION 29

This decision was made by the Secretary prior to submission to him of the companies' environmental report for Nipple Bench.

After reviewing the environmental report, the Secretary agreed that he would consider a power plant proposal for a site farther removed from these two areas of concern. Accordingly, the companies initiated a siting study north of the Nipple Bench site on the Kaiparowits Plateau. As a result of these additional studies, the companies identified four proposed sites: Dry Bench (Site 17), Fourmile Bench (Site 18), Horse Flat (Site 19), and John Henry Bench (Site 8).

A comparison of some important environmental aspects for the John Henry Bench Site, Dry Bench Site and Horse Flat Site follows. Environmental aspects of Fourmile and Nipple Bench have been discussed previously in this statement.

John Henry Bench

Air quality

The John Henry Bench site is in an area of rugged terrain ringed by 1,000-foot bluffs a short distance to the west and north. Smoky Mountain, which rises nearly 500 feet above the site is about six miles to the northeast.

The proximity of high, rugged terrain in the vicinity of the proposed site could cause some air quality problems. Studies identified two potential dispersion problems: plume downwash from winds moving over nearby elevated terrain areas, and trapping of stack emissions by nearby high terrain and infrequent occurrence of elevated stable air layers. The participants estimated that a stack height of about 1,000 feet would be required at this site in order to release stack emissions above nearby terrain features. Because of the complexity of the terrain in the immediate area, it would be necessary to conduct extensive meteorological studies at this site to quantify the nature and extent of the above considerations. No detailed meteorological studies were conducted on John Henry Bench.

Biology

Vegetation on John Henry Bench is a diverse high desert shrub community. The wide variety of perennial shrubs and grasses are valuable as winter and summer food sources for big game animals as well as many small animals.

In addition to loss of high desert habitat, a generating facility on this site could cause an additional impact due to salt drift from cooling towers. This impact would be similar to that on Nipple Bench. It is believed that desert plants are less susceptible to NO_X and SO_X than other plant community types. However, the degree of desert plant species susceptibility relative to other plant communities in the general area is not known.

Archaeology

A single light scatter of chalcedony and jasper flakes was found on the south side of this site. Other similar archaeological materials will probably occur on and immediately adjacent to the site. No known sites of ancient human habitation were located on this site.

Site geology/seismology

John Henry Bench is relatively free from seismic activity. However, because of the close proximity of the coal mine, there is a potential for subsidence of 15 to 18 feet. A thin layer of soil overlays sedimentary rock consisting of the Wahweap formation, interbedded mudstone, siltstone, resistant and non-resistant sandstone, and conglomerate.

Water quality

The existing environment is described in Chapter II and impacts would be the same as those described for the coal mine in Chapter III.

Dry Bench

Air quality

The Dry Bench site is in a canyon surrounded in all directions except to the south by terrain approximately 1,000 feet higher than the proposed plant site. In addition, the Kaiparowits Plateau rising to over 2,000 feet above the plant site is located 12 miles northeast of the site.

Because of the terrain setting at this site location, plume downwash and trapping effects could occur. In addition, since the site is located in a major water drainage area, it could be expected that stack emissions would be transported toward Lake Powell in higher concentrations than from Fourmile Bench by local air drainage winds, and have a greater possibility of interacting with emissions from the Navajo Plant. A stack height of 1,000 feet would be required at this site. As with the John Henry Bench site, extensive meteorological studies have not been initiated and would be required.

Biology

The plant community on Dry Bench is a transition zone of pinyon-juniper and big sagebrush, several species of shrubs and herbs. This area appears to be part of a deer winter range. However, extent of use is unknown.

Dry Bench contains an overlap of high desert and low mountain plant and animal communities and, therefore, is a valuable community since it is an interface between the two communities. The probability of successfully seeding the soil on Dry Bench would be less than three years out of ten years.

Archaeology

A light scatter of chalcedony and basalt flakes, similar to the one recorded at John Henry Bench, was found at this site. Additionally, an isolated projectile point was found.

There is a possibility of pinenut harvesting camps and winter villages occurring on the site.

Site geology/seismology

Dry Bench is relatively free of seismic activity. A thin layer of soil overlays sedimentary rock consisting of Straight Cliffs Formation (Drip Tank member) - containing mainly fine-to-medium grained cross stratified sandstone.

Water quality

Potential impacts to water quality if Dry Bench becomes a power plant site are not known at this time.

Horse Flat

Air quality

The Horse Flat site is located on a gradually-sloping, smooth plateau with no prominent terrain features within five-seven miles of the site.

Because of the relatively high elevation and absence of large, local terrain features, the Horse Flat site is well exposed to winds and relatively good dispersion should occur at this site. A stack height of about 700 feet would be required at this site. Potential impacts to air quality would be the same as those for Fourmile Bench as identified in Chapter III.

Biology

Horse Flat is a secluded area that was formerly pinyon-juniper. This site is of marginal value for deer winter use. Probability of seeding success would be three to five years out of ten years.

The impacts to Horse Flat would be the same as those to Fourmile Bench described in Chapter III.

Archaeology

A small rock shelter, with evidence of aboriginal occupation, was found. It is probable that several other occupied rock shelters will be found on the site.

The chance of an intact archaeological site of major importance occurring

on the site is minimal, due to previous clearing activities. However, surrounding undisturbed areas probably contain intact pinenut harvesting camps, and possibly winter villages.

Site geology/seismology

The Horse Flat site is relatively free of any major seismic activity. A thin layer of soil overlays sedimentary rock consisting of Kaiparowits Formation - sandstone with interbedded mudstone up to 10 feet thick.

Water quality

Impacts to water quality would be the same as those identified for Fourmile Bench in Chapter III.

Summary and comparison of sites to the Fourmile Bench proposal

Air quality

One of the major concerns regarding siting of a generating station in south central Utah is the possible interaction with emissions from the Navajo Plant and effects on visibility in scenic areas, particularly Grand Canyon. The degree of interaction and visibility impact is largely controlled by meteorological conditions at the site and the effects of topography on plume dispersion. Another important parameter is distance separating a generating station from particular points of interest. Separation distance is important, because both magnitude and frequency of occurrence of a given ambient air concentration or visibility impact will, in general, decrease with distance from the generating station. Finally, with respect to plume interaction, elevation differences between the proposed Kaiparowits Station and the Navajo Plant are important in determining the mechanism of plume transport--air drainage winds or synoptic winds.

Consultants for the companies have stated that they do not anticipate that any plume interaction will occur between any of the alternate sites and the Navajo Plant, with the exception of infrequent occasions at the Dry Bench site. This is

based on considerations of both separation distances and elevation differences.

Figure 14 summarizes the distances of separation of the four sites from the Navajo Plant, Page, Grand Canyon (North Rim), Bryce Canyon (Rainbow Point), Zion National Park, and Rainbow Bridge.

Figure 14

Distances in Miles of Alternate Site Power Plant Locations
From other Points of Interest in the Area

Points of Interest	Fourmile Bench (6,160 Feet Elevation)	John Henry Bench (5,000 Feet Elevation)	Horse Flat (5,900 Feet Elevation)	Dry Bench (5,200 Feet Elevation)
Navajo Power Plant	36	27	41	34
Page, Arizona	32	23	36	31
Grand Canyon National Park	76	70	75	79
Bryce Canyon National Park	32	38	24	41
Zion National Park	71	73	63	81
Rainbow Bridge National Monument	44	38	51	36

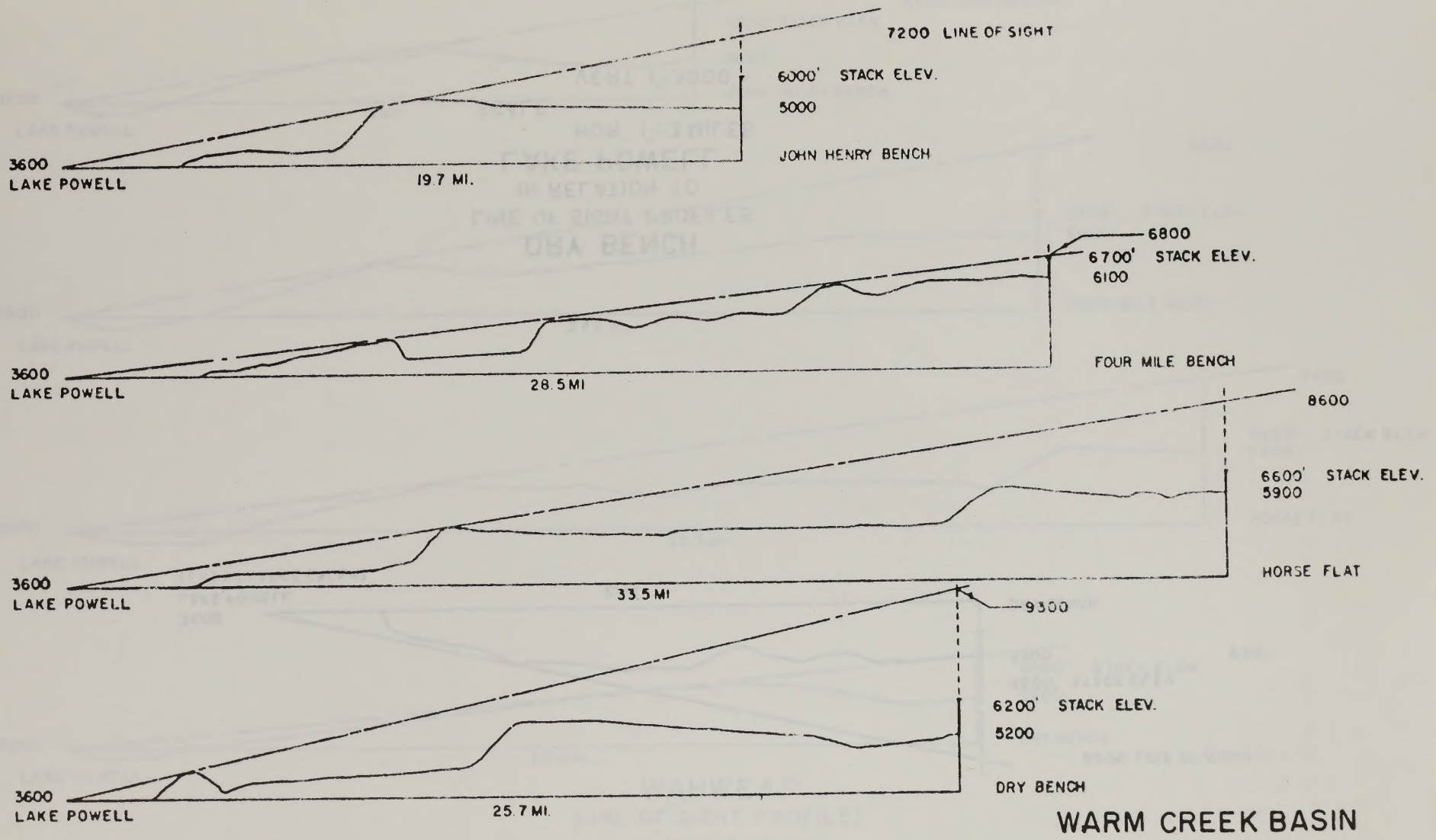
The Fourmile Bench site and the Horse Flat site are generally located farthest from points of interest and importance in this area.

Visibility

Another important aspect considered in the siting of a power plant in the Kaiparowits Plateau area is the visibility of the plant and related structures from scenic areas and other points of interest. Illustrations 30 through 35 are line of sight profiles to various points of interest from four proposed alternate power plant sites.

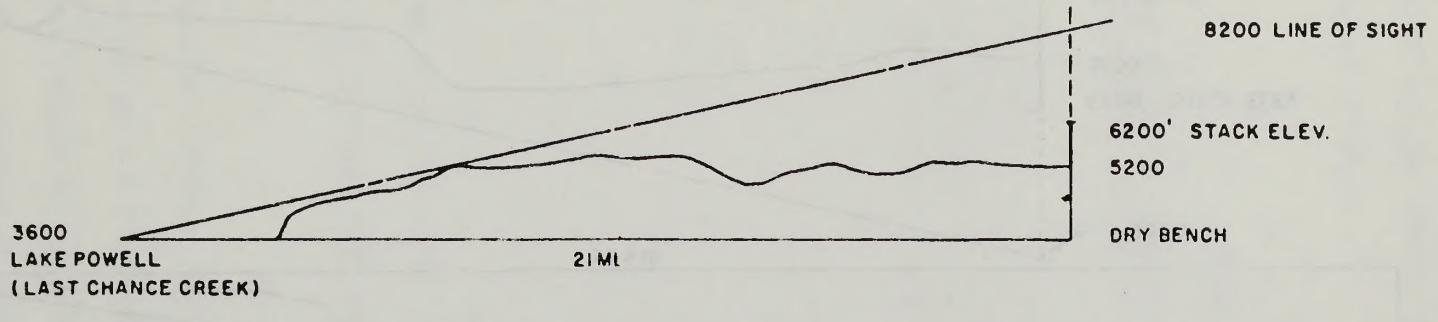
Biological

Regardless of the site chosen for the power plant, impacts to the environ-



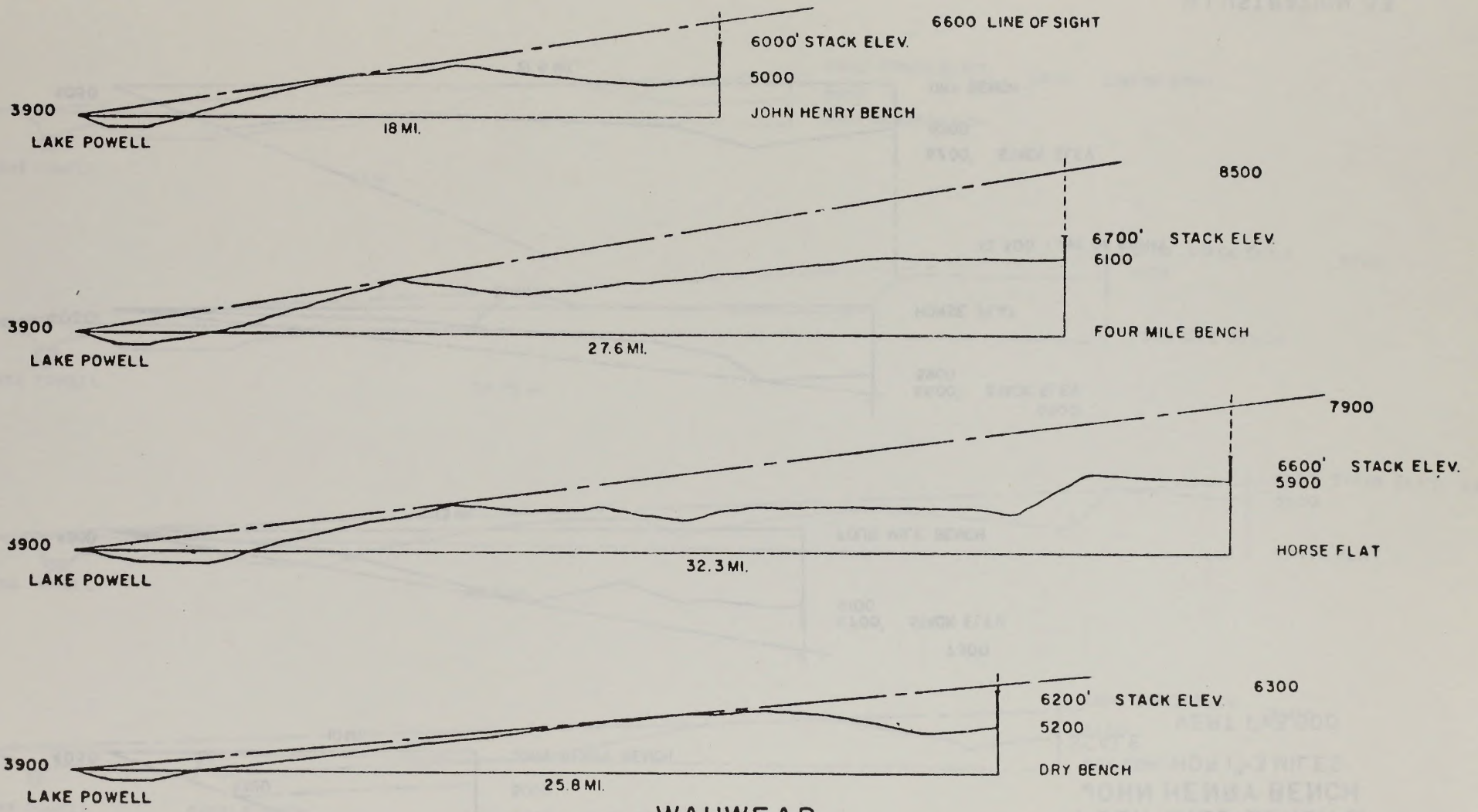
SCALE HOR 1"=3 MILES
VERT 1"=3000'

WARM CREEK BASIN
LINE OF SIGHT PROFILES
IN RELATION TO
JOHN HENRY BENCH,
FOUR MILE BENCH,
HORSE FLAT & DRY BENCH
ILLUSTRATION 30



DRY BENCH
LINE OF SIGHT PROFILES
IN RELATION TO
LAKE POWELL
SCALE HOR 1"= 3 MILES
VERT 1"=3000'

ILLUSTRATION 31



WAHWEAP

LINE OF SIGHT PROFILES

IN RELATION TO

JOHN HENRY BENCH, FOUR MILES BENCH, HORSE FLAT & DRY BENCH

SCALE HOR 1"= 3 MILES

VERT 1"= 3,000

ILLUSTRATION 32

GLEN CANYON CITY
LINE OF SIGHT PROFILES
IN RELATION TO
DRY BENCH, HORSE FLAT,
FOUR MILE BENCH &
JOHN HENRY BENCH

SCALE HOR 1"=3 MILES
VERT 1"=3,000

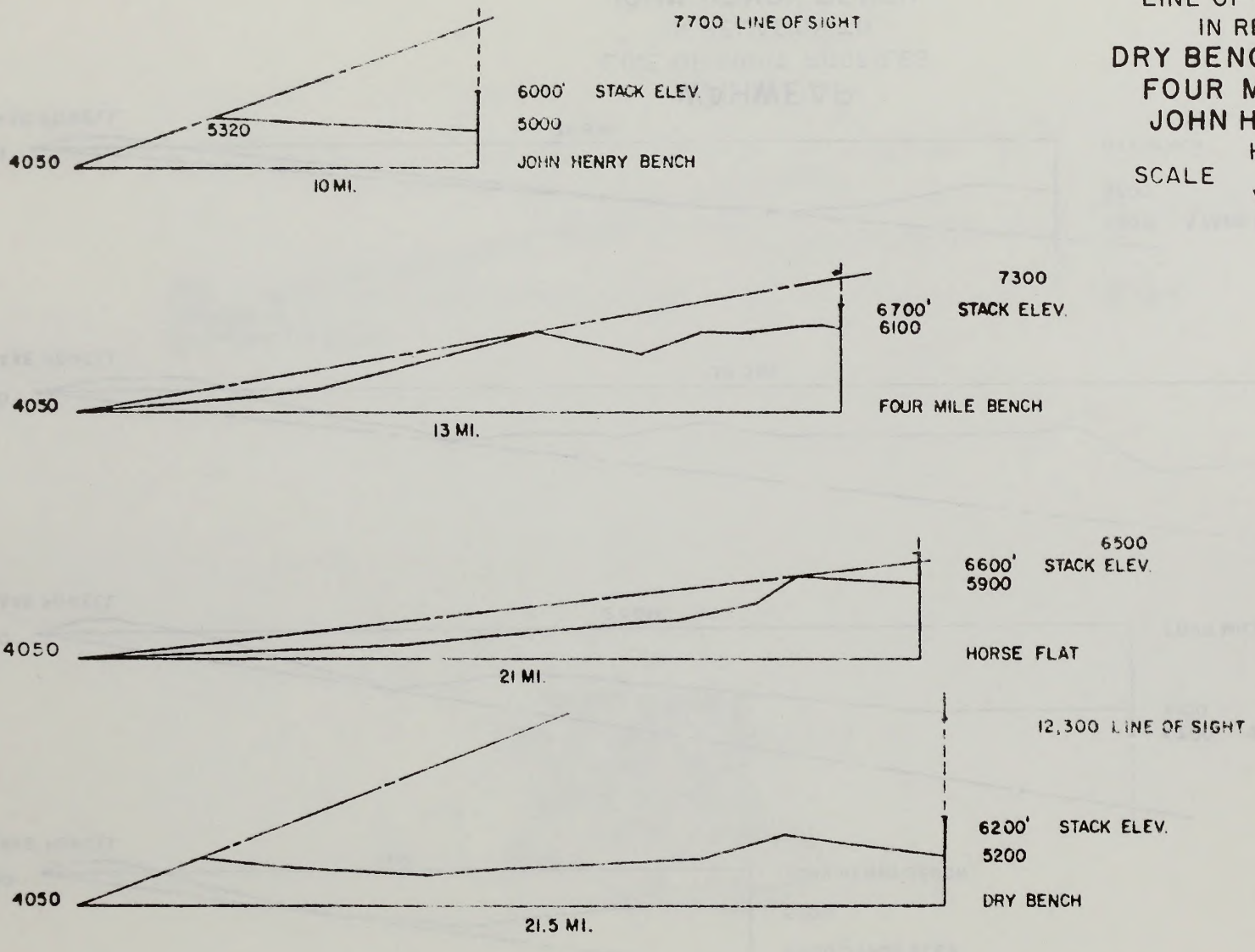
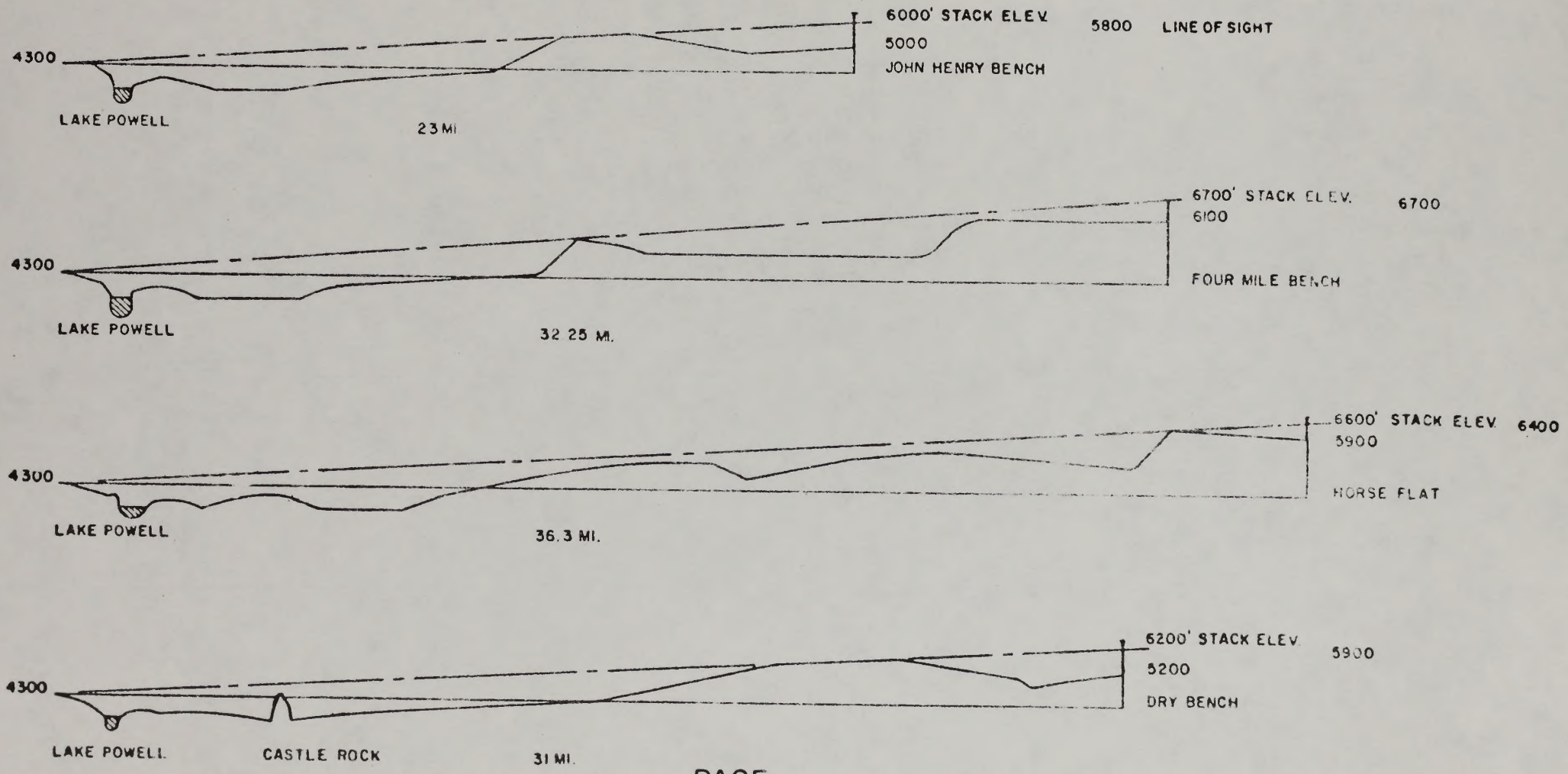


ILLUSTRATION 33

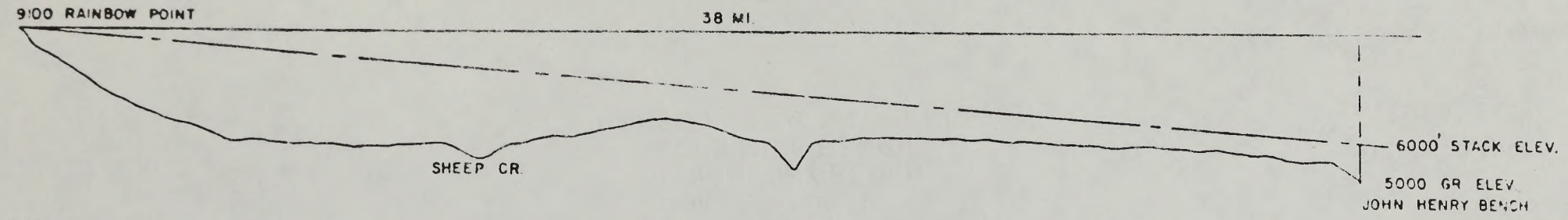


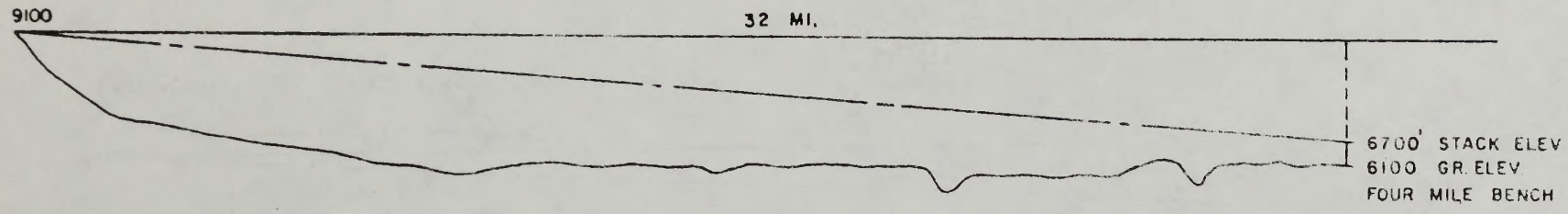
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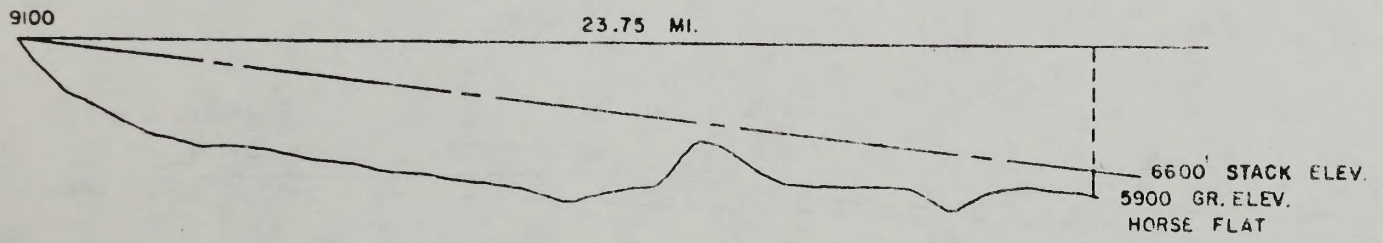
LINE OF SIGHT PROFILES
IN RELATION TO
JOHN HENRY BENCH,
FOUR MILE BENCH,
HORSE FLAT & DRY BENCH

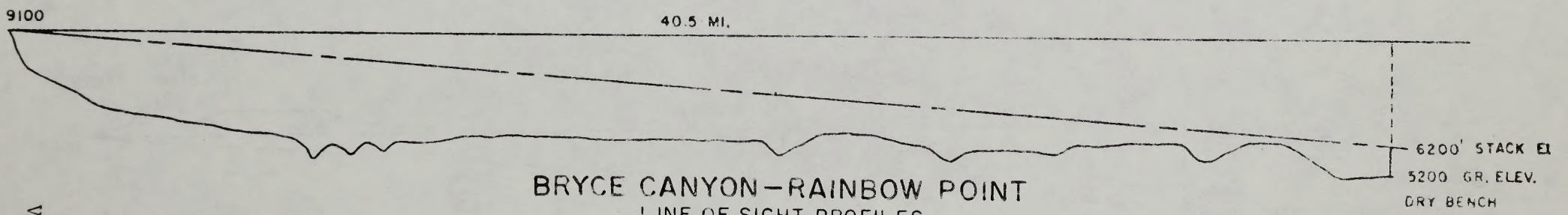
SCALE HOR. 1"=3 MILES
VERT. 1"=3,000

ILLUSTRATION 34









BRYCE CANYON—RAINBOW POINT

LINE OF SIGHT PROFILES
IN RELATION TO
DRY BENCH, HORSE FLAT,
FOUR MILE BENCH &
JOHN HENRY BENCH

SCALE
HOR. 1"=3 MILES
VERT. 1"=3,000'

ILLUSTRATION 35

ment would not vary from those already discussed in Chapter III. There is not enough data on each site proposal and access road routing to effectively evaluate impacts.

Archaeology

Baseline information regarding alternative sites is insufficient to effectively evaluate potential impacts to archaeology.

Site geology/seismology

Dry Bench and Horse Flat are approximately the same as Fourmile Bench. However, John Henry Bench could be subjected to a potential subsidence of 15 to 18 feet due to underground coal mining.

Water quality

There is not enough data on each site proposal and access road routing to effectively evaluate the impact to water quality.

Figure 15 shows relative ranking of alternative sites with respect to environmental and economic/engineering factors, based on the participants siting study. Since factors that were evaluated are not equal or easily compared, weighting values were assigned to each factor to facilitate comparison. A low number, indicating more favorable ranking compared with other sites, does not indicate minor or minimal impacts. A generating station located at a site ranked number 1 for any given environmental factor could cause significant disturbances, but they should be less than if a plant were located at the other higher ranking sites.

The participants concluded from their findings that the sites would have the following order of environmental economic, and engineering feasibility: (1) Fourmile Bench, (2) John Henry Bench, (3) Nipple Bench, (4) Horse Flat, (5) Dry Bench.

John Henry Bench could be a suitable site since it is nearest

FIGURE 15

Comparative Ranking of Alternative Sites in the Kaiparowits Plateau

Environmental factors	John Henry Bench	Dry Bench	Fourmile Bench	Horse Flat	Nipple Bench
Visibility of plant and plume	2[a]	2	1	2	3
Visibility of transmission structures	1	1	2	2	1
Plume dispersion	3	3	1	1	2
Plume interaction with Navajo Plant	2	2	1	1	2
Biological	1	2	2	2	1
Archaeological and Scenic	1	2	3	3	1
Construction effects	1	3	2	3	2
Noise attenuation	1	1	1	1	2
Economic/engineering					
Coal conveyance	1	2	3	4	2
Water conveyance	1	2	3	4	1
Transmission routing	1	3	2	3	1
Site access and adaptability	2	2	1	1	1
Availability of ash disposal sites	2	4	1	3	1

[a]1 = Most favorable (least environmental impact, least cost and/or engineering difficulty); higher numbers = less favorable (greater environmental impact, more cost and/or engineering difficulty). The same number for different sites indicates that there would be little difference between sites. Adapted from Southern California Edison - Southern Utah Siting Study, November 9, 1973.

the mining area, thereby allowing shorter service roads, some centralized surface facilities, and shorter water and coal delivery systems, with some reduction in overall environmental impacts. However, a generating station on John Henry Bench may be over minable coal, which could prevent recovery or make mining hazardous. There also appears to be a greater likelihood of air pollution there than at all other sites except Dry Bench.

Horse Flat is similar to Fourmile Bench with respect to potential environmental disturbance, but its location would require longer coal and water delivery systems, with resulting environmental impacts. Dry Bench would also require longer coal and water conveyance than any of the sites, except Horse Flat. Dry Bench is generally less satisfactory because of relatively poor plume dispersion potential. In addition, transmission lines would have to be longer than at other sites.

These alternative plant sites would also have to be evaluated with respect to potential town sites. Only Nipple Bench, John Henry Bench, and Fourmile Bench may be near enough to a town on East Clark Bench to be suitable for most commuters. A town at Butler Valley or Long Flat would be near a generating station at Horse Flat or Fourmile Bench, but may be less desirable for most commuters with respect to a generating station at Dry Bench or Nipple Bench. A town on Fourmile Bench may be a suitable location for most potential residents commuting to any of the alternative sites.

A generating station at any alternate site except John Henry Bench would require re-routing the proposed access highway. Studies have not been made to determine the most feasible route for each site, but all sites would require a longer access highway than the proposed highway that could serve Fourmile Bench or Nipple Bench. Cumulative impacts and cost would, therefore, be greater.

Other possible alternate bench top sites, which apparently were not considered by the participants, include Jack Riggs Bench, Window Sash Bench, and Paradise Bench. None of these sites appear to have significant advantages that would reduce environmental disturbance if they were selected for location of a generating

station. Jack Riggs Bench is about 12 miles northwest of Nipple Bench, and has a surface elevation of about 5,400 feet. Higher terrain to the north may inhibit air dispersal, and local terrain would make access difficult and expensive. Coal and water delivery systems would be longer than for most other sites, and would have to cross or avoid several canyons, resulting in additonal aesthetic and environmental impacts.

Window Sash Bench is about five miles north-northeast of Dry Bench. Average elevation is about 6,000 feet. There is higher terrain immediately to the west. Fiftymile Mountain is about 11 miles to the east. Although air dispersal characteristics may be favorable, the site is on a coal lease and would be about five miles from the mining area.

Paradise Bench, about six miles northeast of Fourmile Bench, averages about 6,000 feet in elevation. Air dispersal characteristics should be favorable because of absence of nearby higher terrain, but this site is near coal leases and may be over minable coal. Coal and water conveyance systems would have to cross canyons or be routed along canyons of Last Chance Drainage. Access to Window Sash and Paradise benches would require a longer highway than the proposed route, and additional cuts, fills, and bridges to cross intervening canyons.

ALTERNATE GENERATING STATION SITES OUTSIDE UTAH

Consideration of locating a large generating station either in or outside of Utah must include (1) probable unavoidable environmental impacts, (2) likelihood of meeting State and Federal air and water quality standards, (3) physical and legal availability of water, (4) availability of fuel, and (5) acceptance of the project by local populace. These considerations are not in any particular order of importance; they vary considerably with location.

California

The probability of a coal-fired generating plant meeting the stringent air quality standards of California Air Pollution Control Districts is low, even with present emission control technology. The addition of another emission source into control districts which do not presently meet ambient air quality standards would be prohibited. Therefore, present air quality standards in California eliminate much of that state for coal-fired generating stations such as the Kaiparowits proposal. When Southern California Edison proposed a generating station near Barstow, California several years ago, a referendum was brought against the proposal by people of the area; approval could not be obtained.

Nevada and Arizona

An alternative to the proposed project, which might meet the participants' expressed needs, would be to expand generating capacity of Mohave and Navajo plants in Nevada and Arizona, using coal either from Kaiparowits Plateau or Black Mesa, Arizona. The following is a discussion of considerations involved in such alternatives.

Mohave Generating Station is in southern Clark County, Nevada, west of the Colorado River, on a 2,500 acre site in Township 32 South, Range 66 East, Mount Diablo Base and Meridian. The site is at an elevation of 700 feet above mean sea

level in Mohave Valley, which is bounded on the east by mountain ranges that reach elevations of over 5,000 feet.

The site includes several broad, flat washes that slope gently toward the Colorado River. The valley floor at the site is sand and gravel. Evidence of faulting and recent earthquakes within 50 miles of the site indicate that likelihood of earthquakes is low. Creosote bush is dominant at the site. Endangered species are not in evidence, but the desert tortoise, a protected species, is found. Archaeological surveys, consisting of reconnaisance of the area in the vicinity of the generating station have located six archaeological sites.

Two or four additional 750 mw units would increase Mohave station generating capacity to 3,000 or 4,500 mw. According to the participants, base plant facilities for a 4,500 mw plant would be the same as proposed for Kaiparowits. The facility would be designed to meet all applicable air quality requirements.

If the Mohave plant's capacity were increased by 3,000 mw, an expansion of the Navajo station might not be necessary. An additional 3,000 mw of generation at the Mohave generating site would involve two Mohave-Devers 500 kv lines and two Devers-Serrano 500 kv lines. The Arizona participants' share could be transmitted over the existing 500 kv system to the Navajo and Moenkopi substations. From Moenkopi, however, a 500 kv line to the Liberty Substation, and a Liberty to Westwing 500 kv line would be needed. No new transmission requirements would be necessary for the San Diego Gas and Electric Company's share of the 3,000 mw.

Coal is presently delivered to the Mohave plant through a 275 mile slurry pipeline from Black Mesa, Arizona. Coal for an expanded plant could be transported by rail. According to participants, the Mohave station could be serviced by Atchison, Topeka and Santa Fe Railroad by building a rail spur approximately 230 miles long from the Kaiparowits coal field to Flagstaff, Arizona, to connect with the A.T.&S.F. rail line and a 23 mile spur from the rail line junction in Piute Valley, California, to the Mohave plant site.

Additional alternative coal delivery systems would be (1) a rail line more than 200 miles long from Kaiparowits Plateau to near St. George Utah, and north to the Union Pacific spur at Cedar City, or (2) an additional or enlarged slurry pipeline from Black Mesa, Arizona, or (3) a 350 mile Kaiparowits to Mohave slurry line.

The Navajo Generating Station is four miles east of Page, Arizona. The site is on a low bench, 3½ miles from Lake Powell, at an elevation of about 4,360 feet above mean sea level. Higher terrain is to the south. Blackbrush is the predominant vegetation in the area of the generating station. Facilities occupy about 2,200 acres, and present generating capacity is 2,250 mw. An additional 750 mw unit would increase the total generating capacity to 3,000 mw.

The transmission system serves the Phoenix area via the Moenkopi Substation and Los Angeles via the McCullough Substation in Nevada. Coal is supplied from the Black Mesa mine by an 80 mile railroad.

The Black Mesa Mine is a strip-mining operation on 64,858 acres of tribal lands leased by Peabody Coal Company from the Navajo and Hopi. The mesa is a moderatley dissected highland about 4,000 to 7,000 feet above mean sea level, and is covered by mixed grassland, sagebrush grassland, and pinyon-juniper woodland, depending on elevation. The mine is expected to supply five million tons of coal annually to the Mohave plant and eoght million tons to the Navajo plant by 1976, when all units should be completed and in full operation. Peabody expects to mine an average of 400 acres each year, and to restore and revegetate the mined area.

Probable unavoidable impacts resulting from expansion of Mohave, Navajo, and related facilities would include air quality, spreading and intensification of impacts at each site, and additional impacts resulting from new railroads or slurry pipelines.

Both Mohave and Navajo plants are presently being extensively studied to determine concentrations of sulfur and nitrogen oxide and particulate that come from present plant operation. Results of these studies would pro-

vide a basis for assessment of impact on air quality as a result of an increase in the generating capacity of these two plants.

Increasing the combined generating capacity of Mohave and Navajo stations from the presently designed total of almost 3,760 mw to more than 6,000 mw would almost double the present requirement for coal, to more than 20 million tons a year. If additional coal were supplied from Kaiparowits Plateau, environmental impacts would be similar to those already discussed in this statement for the proposed project, except for disturbances directly attributable to the proposed generating station and transmission system. However, a railroad or slurry line would result in several additional impacts. Impacts due to a railroad would depend on whether the route would be from Kaiparowits to Flagstaff or to Cedar City. Specific impacts cannot be identified until actual railroad or slurry line routes are identified.

The "participants" suggestion of a rail line from Kaiparowits to Flagstaff raises questions as to the technical means of tranporting coal across the Colorado River near the Kaparowits Plateau, and whether rights-of-way for such a crossing and for a route through lands administered by the National Park Service and through Navajo Tribal Lands could be obtained. Therefore, a more feasible route for either rail or pipeline might be to Cedar City, perhaps roughly parallel with the proposed highway via Nipple Creek, US 89 towards Kanab, the highway from Fredonia, Arizona, to Hurricane, Utah (Arizona 389 and Utah 59), and Interstate 15 to Cedar City.

Impacts due to a railroad to Cedar City would include: more than 200 miles of right-of-way disturbance, with cuts, fills, culverts, eradication of vegetation, and disruption of present land uses along the route; noise, air pollution, and risk of accidents; and irretrievable loss of locomotive fuel. The railroad could also be used for passenger service and freight to the region (more inexpensively than current automobile and truck haulage), and it might stimulate growth of industry.

The proposed railroad from Kaiparowits to Cedar City, Utah, via St. George, Utah would disturb approximately 1,300 acres more than the power plant proposal on Fourmile Bench. Also there would be an adverse impact to scenic areas such as Zion National Park.

Impacts due to a slurry line about 350 miles long would occur mostly during construction, when trenching and staging would eradicate vegetation and scar the earth. If rehabilitation of disturbed areas were successful, however, these disturbances would generally be mitigated. Pumping stations and points where the line would be above ground would remain visible. Also, the slurry would require approximately 41,290 acre-feet less water than the power plant. However, 41,400 acre-feet of additional water would be needed at Mohave if its capacity was expanded to 3,000 mw.

Expansion of the Black Mesa coal mine would disturb considerably more surface area than is likely with the present project. It would cause disturbance during construction of an additional or larger slurry pipeline, and displace more Indian families. Expansion to a 20 to 24 million ton per year mine would require additional expenditure of material, but it would increase capital and employment in northeastern Arizona.

Increasing the generating capacity of the Mohave plant by 1,500 mw to 3,000 mw and the capacity of the Navajo plant by 750 mw could require an additional commitment of 41,000 to 72,650 acre-feet of water. This assumes 33,750 to 56,250 acre-feet used in wet cooling towers at the generating stations, 2,400 to 6,500 acre-feet in a slurry pipeline from Black Mesa or Kaiparowits, 5,000 acre-feet for municipal use, and 5,000 acre-feet for underground mining needs in the Kaiparowits Plateau. Adequate amounts of water to supply these needs are physically available from the Colorado River and, for slurry and municipal purposes, from underground storage. However, several legal constraints would have to be met to permit actual use of the water. These can be identified with the three states that could be involved - Utah, Nevada, and Arizona.

The participants' rights and water service agreements with the State of Utah and the Department of the Interior specify that up to 120,000 acre-feet of water from the Colorado River is to be used only for steam-electric generation in Kane County, Utah, utilizing coal mined in the Kaiparowits Plateau. If the project is abandoned, rights to use the water would revert to Utah. Under these agreements, therefore, water for mining, slurry transport, and municipal use would not be available if the generating station were located outside of Utah. These alternate uses would require renegotiation to obtain new agreements. Use of Utah's allocation of Colorado River water for cooling a generating station in another state could require an Act of Congress, including possible modification of the Colorado River Compact which governs allocation of water.

The State of Nevada is allotted 300,000 acre-feet of water annually from the Colorado River. This amount may be inadequate for the immediate future requirements of southern Nevada. The Colorado River Commission of Nevada has contracted with the Southern California Edison Company for delivery of 30,000 acre-feet of water annually from Lake Mead. This water which will be used by the present Mohave power plant, is to be made available until July 1, 2006. No provision is made to extend the contract beyond that date. An alternative source of cooling water for additional generation in southern Nevada would be reclaimed waste water from the City of Las Vegas, but this water is planned for use by the proposed 2,000 mw Harry Allen Project scheduled for commercial operation during 1979-82.

Arizona's Colorado River water Upper Basin allocation, which would affect the Page area, is 50,000 acre-feet per year. The water service contract to permit use of Colorado River water for the Navajo Generating Station permits withdrawal of up to 40,000 acre-feet per year. The present Navajo Generating Station is expected to use an average of 34,000 acre-feet annually. The balance of 6,000 acre-feet is insufficient for an added 750 mw unit. Assuming that a wet cooling tower would be

used, an additional unit would require about 11,250 acre-feet, exceeding the contract limits by about 5,250 acre-feet.

Water supply for the Black Mesa-Mohave slurry system is obtained from deep wells, which are partly lined in an effort to prevent draining water from the shallower perched aquifers penetrated by Navajo and Hopi wells. Although it is estimated that there is an abundant supply of deep subsurface water (Bureau of Reclamation, 1972), the possibility of interfering with present and future Indian water needs exists.

An appropriate selection of methods could mitigate some of these problems. For example, a combination of wet/dry cooling towers for additional generating units at Mohave and Navajo would reduce the water requirement, possibly to a level where cooling water needs could be met legally and physically. A railroad rather than a slurry line from Kaiparowits or Black Mesa would eliminate the need for slurry water. Municipal water requirements, estimated at a total of up to 5,000 acre-feet annually, would probably not be required entirely at one location. The increase in requirements might be relatively small at Page and Black Mesa, for example, and might be very small in the Kaiparowits area if coal was not supplied from Utah.

Sufficient coal is present in the Kaiparowits Plateau and under lease by the participants to supply the needs for alternative generating station locations. An adequate supply of coal is known to exist and is under lease at Black Mesa to supply present generating station needs, but it is not known if there are sufficient reserves of minable coal to supply expanded generating stations. Such possible reserves are not presently under lease.

Attitudes of local residents most likely to be affected by these alternatives are unknown at this time. In particular, attitudes of the Navajo and Hopi would be significant if the alternatives included expansion of the Navajo Generating Station and the Black Mesa Mine. Negotiations would be necessary to obtain

permits for exploration for additional coal, for additional coal leases, rights-of-way, and water rights, and possibly for leasing more land.

If no coal were to be supplied from Utah, alternatives of meeting the participants' estimated needs by expanding the Mohave and Navajo generating station and using coal from Black Mesa would eliminate impacts indicated in this statement as likely to occur in Utah. Impacts would be confined largely to locations already identified for steam-electric generation, coal mining, and transmission of electricity, coal, and water. Generating sites would be closer to load centers, reducing some environmental disturbance and use of material for transmission system construction. Much of the impact would be on Navajo and Hopi Tribal Lands. Although this would include increased employment and income, it would also involve displacement of people, environmental and cultural disturbance, and long-term and irretrievable commitments of resources. Other impacts would occur along the coal conveyance route, but would vary according to route and whether transport was by rail or slurry pipeline. There would be additional impacts in the vicinity of the Mohave and Navajo generating stations, particularly with respect to air and water quality and socioeconomic conditions.

Feasibility of these alternatives would depend on such factors as: environmental impacts that could result, compared to those that could occur with the proposed Kaiparowits project; availability of water and of coal at Black Mesa; whether additional coal leases could be obtained at Black Mesa; and technological and economic considerations. Economic considerations including efficiency of various alternatives, which involve relative amounts of usable energy obtained from resources, are discussed in the Federal Energy Administration report (Appendix I-1 of this statement).

ALTERNATE LIMESTONE QUARRY SITES

The proposed quarry site selection was based on consideration of many factors: limestone quantity and quality, transportation distance, existing highways, environmental impact resulting from quarrying, attitude of limestone beds and the amount of overburden. The limestone quality could not exceed 4% silicol when used for rock dusting. This was established by MESA to avoid the potential problem of silicosis of the lungs of miners.

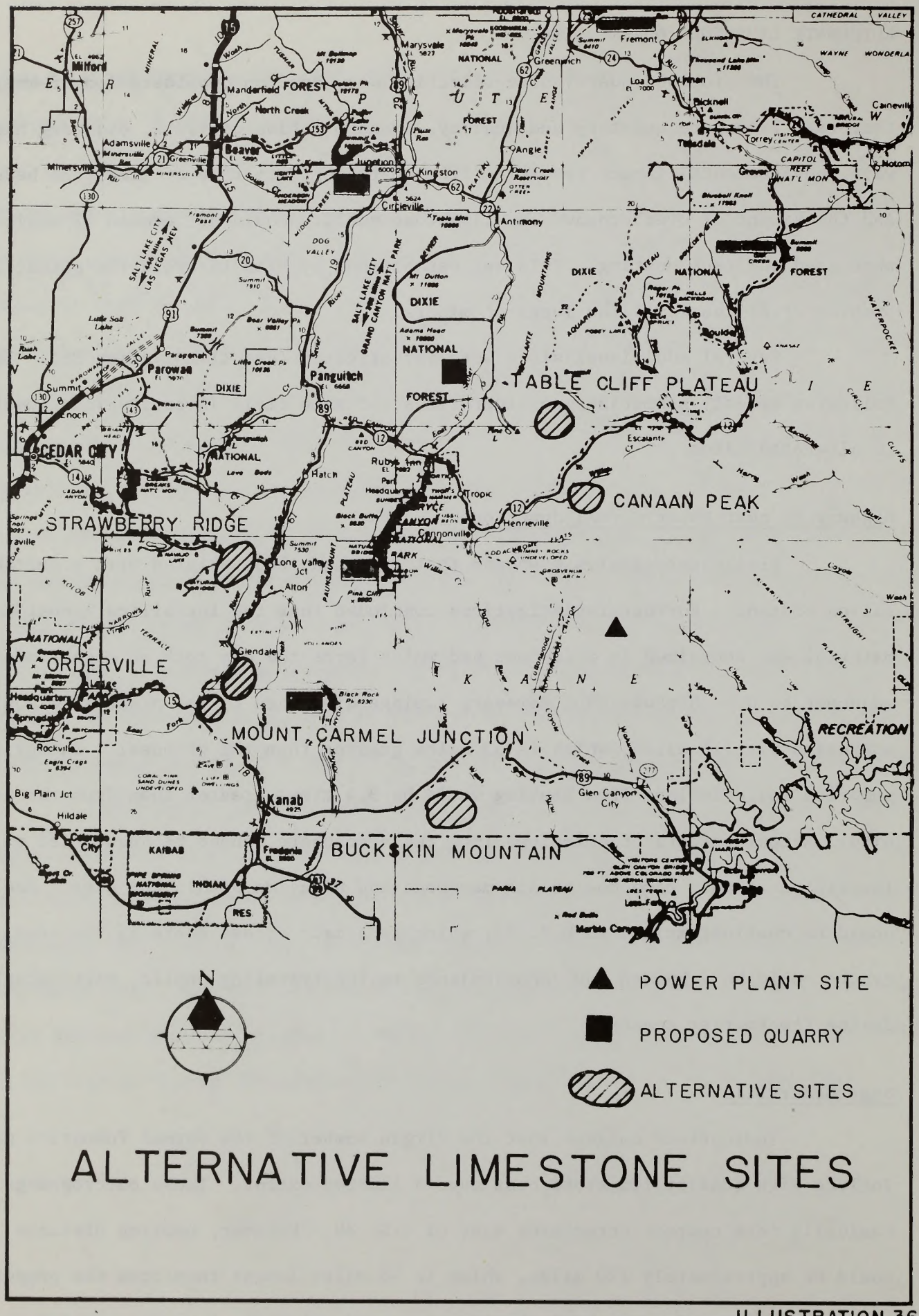
Several additional sites were investigated (see Illustration 36). The following briefly summarizes considerations and main field investigations involved in alternate sites.

Highway 89 near Mount Carmel Junction

Preliminary analysis showed that limestone beds existed with a suitable silica content. Further investigations concluded that the low-silica limestone material was contained in a 15-foot bed which forms the cap rock of mesas immediately adjacent to U.S. Highway 89. However, haulage distances to the plant site would be approximately 115 miles, which is 53 miles greater than the proposal. Energy consumption and emissions from hauling would be 3.4 times greater than from the proposed site. Actual effects of emissions into the atmosphere cannot be quantified or identified at this time due to air movement and dilution within the area. Hauling would be confined mainly to U.S. 89, which is a main access route in the area, and trucks could be a hazard and inconvenience to the traveling public, particularly during the tourist season.

Near Orderville

Indications suggest that the Virgin member of the Carmel Formation may include high quality limestone beds over a limited extent. These outcroppings basically form caprock structures east of U.S. 89. However, hauling distance would be approximately 120 miles, which is 58 miles longer than from the proposed site. Energy required to haul the limestone and emissions into the atmosphere



ALTERNATIVE LIMESTONE SITES

ILLUSTRATION 36

would be 3.7 times greater than haulage from the proposed site. U.S. 89 would also be the primary hauling route. Impacts to the atmosphere cannot be quantified or identified at this time.

Strawberry Ridge

This is the same strata which is found at the Johns Valley site. However, this site is 35 miles further away from the Fourmile Bench area than the proposed site. Energy consumption and emissions into the atmosphere would be increased 2.5 times. Hauling would be along U.S. 89 and through Bryce Canyon National Park.

Table Cliff Plateau

Outcropping rock formations on this mesa contain limestone that would be acceptable for rock dusting material. This is the same strata which is found at the Johns Valley site. Ten miles of all weather road to the mesa top would have to be constructed. Clearing 300 acres of heavily-timbered area would result from quarrying this site. Severe winter conditions could double the energy requirements to allow haulage year-round. Emissions to the atmosphere would also double. An additional 120 acres would be disturbed as compared to the proposed site. This would result in an adverse visual impact and possibly eliminate an additional six head of deer, when compared to the proposed site.

Canaan Peak

If future geologic reconnaissance find favorable material, this site would present the best alternate site to supply the Kaiparowits project with limestone. This site would eliminate the haulage segment through Bryce Canyon National Park and reduce the haulage distance by 40 miles to Fourmile Bench or Nipple Bench.

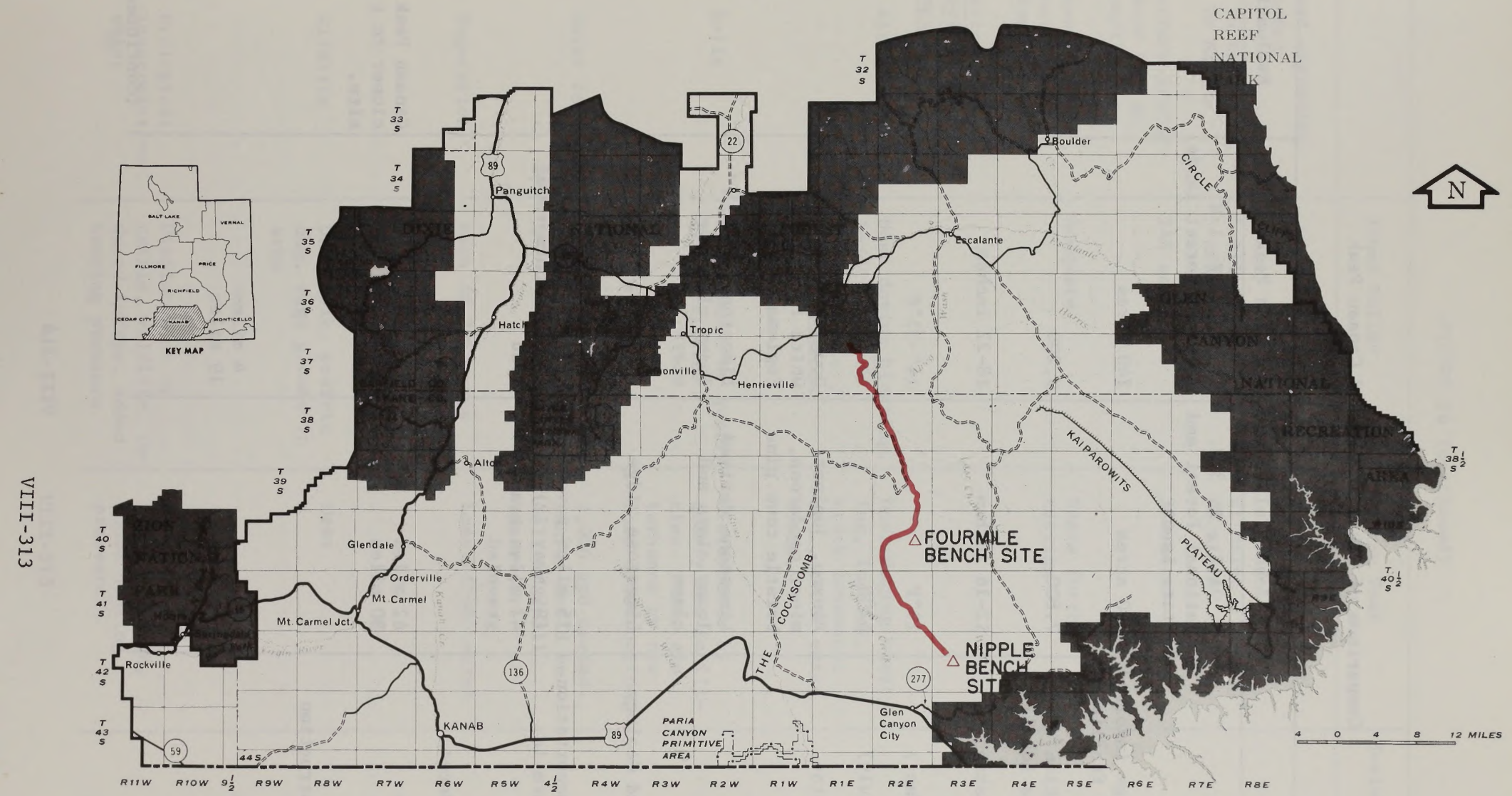
The Canaan Peak site is on National Forest lands in Section 4, T. 37 S., R. 1 E., around 9,000 feet in elevation. Resources Company has staked 28 placer mining claims, covering about 560 acres. They are currently testing limestone from this site. The area is tree covered and has been partially logged, the

remaining stand consists of Douglas fir, white fir, and some Engelmann spruce. Logged areas have been planted with Douglas fir. The area under claim is included in the Upper Valley East cattle allotment and accounts for approximately 30 AUM's per year. The area is part of the headwaters of Canaan and Willow Creeks which flow intermittently. The creeks join farther down the mountain and eventually flow into the Escalante River. The area is used as summer range by mule deer. Deep snow forces most wildlife out of the area in winter.

A proposed haul road from Canaan Peak would traverse south down the mountain to where it would connect with one of the proposed alternative access roads to Fourmile or Nipple Bench sites (see Illustration 37). Figure 16 is a comparison table of the Johns Valley and Canaan Peak limestone quarries.

Surface disturbance on quarry sites would be approximately the same for both the Johns Valley proposal and the Canaan Peak alternative. The Canaan Peak alternative would be consuming 60 percent less energy hauling limestone, therefore depositing 60 percent less emissions into the atmosphere. However, there would be 150 more acres of surface disturbance during construction of the Canaan Peak alternative than the Johns Valley proposal due to upgrading and construction of 25 miles of road. Such disturbance would result in an additional 0.02 acre-foot of sediment being deposited into Lake Powell each year until reseeding occurs. Effects of this sediment to the fisheries in Lake Powell is not known at this time.

Surface rehabilitation by seeding would have a probability of success of five to seven years out of ten years. After rehabilitation there would be a loss of 105 acres more vegetation on the Canaan Peak alternative than on the Johns Valley proposal due to physical occupation of road surface. This loss of vegetation would reduce grazing capabilities for an additional 5 head of deer and 30 AUM's of livestock grazing when compared to the proposed site.



PROPOSED HAULAGE ROUTE FROM THE CANAAN PEAK ALTERNATE QUARRY SITE TO FOURMILE AND NIPPLE BENCH SITES

KANAB DISTRICT
1974
UTAH

ILLUSTRATION 37

FIGURE 16

Comparison of Johns Valley and Canaan Peak
Limestone Quarry Sites

	Johns Valley	Canaan Peak	Evaluation
Location	T. 34 S., R. 3 W. National Forest and State Lands	T. 37 S., R. 1 E. National Forest lands	
Approx. acreage involved in the quarry facilities	240 acres	240 acres	
Approx. Elevation (ft. above sea level)	7,800	9,200	
Ann. precipitation (in.)	12-16 inches	18-22 inches	
Ave. temp. (Jan.)	19°F	14°-35°F	
Ave. Temp. (July)	62°F	45°-78°F	
Dominant vegetation type	Pinyon, juniper minor ponderosa, bristle cone pine	Douglas fir, white fir, Englemann spruce	
Soils	Limestone derived loamy clays and clays	Limestone derived loamy clays and clays	
Topography and Geology	Limestone ridge	Dissected limestone plateau	
Existing transportation routes to Fourmile Plant site	15 miles paved (Highway 12) 47 miles graded/ graveled	4 miles-no access 21 miles-unimproved road	
Approx. Distance:			
To Fourmile	62 miles	25 miles	Canaan Peak site closer to plant site.
To Nipple	80 miles	40 miles	
New road construction needed:			
To Fourmile	None	4 miles	
To Nipple	None	19 miles	

(continued)

FIGURE 16 (continued)

	Johns Valley	Canaan Peak	Evaluation
Road upgrading needed:			
To Fourmile	5 miles	21 miles	
To Nipple	5 miles	36 miles	
Surface disturbance during construction	240 acres	390 acres	
Quantity and quality of limestone	Adequate	Needs further testing	
Anticipated Environmental Impacts:			
Air quality	Dust during blasting, loading, truck movement, etc., truck emissions	Dust during blasting, loading, truck movement, etc., truck emissions.	Less haulage distance from Canaan Peak, therefore less engine emissions, less movement along roads.
Soils	Disturbance by quarry and facilities	Disturbance by quarry and facilities. More disturbance by new road construction.	More disturbance by Canaan site due to new road construction.
Water resources	Water well 2,000 gpd	2,000 gpd needed. Source could be well or small reservoir.	
Vegetation	Loss of 240 acres	Loss of 345 acres	Pinyon-juniper removal at Johns Valley. Fir and spruce at Canaan Peak.
Wildlife	Deer, elk, prairie dog, sage grouse in area	Deer	Less wildlife variety at Canaan site - Displacement of wildlife both sites and added hunting pressure.
Ecological interrelationships	Displacement of cattle, wildlife, reduced forage, added hunting pressure.	Displacement, reduced forage, added hunting pressure.	

(continued)

FIGURE 16 (continued)

	Johns Valley	Canaan Peak	Evaluation
Paleontological, archaeological, historical	Arch. sites have been inventoried and preserved	No inventory at this time	
Recreational resources	Better access into area will be gained for hunters. Added hunting pressure. Quarry can be hidden from major view.	Better access into area will be gained for hunters. Added pressure. Area has good recreational potential (camping, etc.) Road scars along new access. Quarry can be hidden from major view.	Canaan site will involved road scars. Canaan site has better potential for recreational use (camping, etc.) because of forest.
Land uses:			
Livestock	64 AUM's affected	30 AUM's affected	More grazing on Johns Valley site.
Recreation	Increased access into area for recreational use. Trucks travel through Bryce Canyon N.P. and tourist road.	Increased access into area for recreational use. Little impact on tourist use.	Canaan Peak site would have less affect on tourist traffic into-out of Bryce National Park
Mineral development	No other mineral development in area	No other mineral development in area	
Wood products	Not logged, potential low. 50,000 bd. ft. ponderosa pine would be cut. Fence posts firewood affected.	Area has been logged and replanted in late 1960's. Potential for firewood, posts, Christmas trees.	Canaan site has high wood products potential which would be lost.
Agriculture	Small agricultural use nearby. Use water from spring near site.	No agriculture	
Transportation facilities	Existing roads including paved highway (U-12)	Existing roads and new road construction	Need new road construction for Canaan.
	Limestone trucks travel through part of Bryce Canyon N.P. and two small towns (Tropic, Cannonville) as well as logging trucks, oil trucks.	No major traveled roads would be traversed, no towns encountered, site would avoid Bryce Canyon.	Canaan site haulage would involve less exposure to accidents, traffic problems, would not be offensive to tourist traffic in Bryce Canyon area.

ALTERNATE ACTIONS BY GOVERNMENT AGENCIES

The following discussion lists possible alternatives that might be taken by state and federal agencies to implement participative actions for development of the Kaiparowits coal-fired power generating project, and legal authorities for these alternative approaches.

Federal

(The Bureau of Land Management would be the only federal agency that could provide land for a town site or the power plant site).

Bureau of Land Management

The State of Utah has filed application to acquire federal lands that would be needed for either the Fourmile Bench power plant site or the Nipple Bench power plant site. However, no application for the townsite has been filed with the Bureau of Land Management.

There are three approaches whereby federal lands can be utilized for the steam generation plant and the townsite. All of these approaches require that title of these lands pass from federal ownership to the State of Utah. The State of Utah can then dispose of these lands in any manner that they deem necessary. However, before any public lands could be transferred to the State of Utah these same lands would need to be classified by the Secretary of the Interior under Section 7 of the Taylor Grazing Act (43 U.S.C. SS 851, 852) which would remove the withdrawn status of these lands.

The first method by which the State of Utah could acquire these lands would be by filing an application under the State Grants Indemnity Selection as authorized by Sections 2275 and 2276 of Revised Statutes, as amended (43 USC 851, 852). The law provides that a state may select equal acreage within its boundaries for grant lands lost to the state because of appropriation before title could pass to the state or because of natural deficiencies resulting from such causes as fractional sections

and fractional townships. Lands would be selected generally from unappropriated, nonmineral public lands.

The second approach that could be used to pass title to the State of Utah would be a Quantity and Special Grant Selection, as authorized by Sections 2275 and 2276 of the Revised Statutes, as amended (43 USC. 851, 852). The law provides the state may select up to 6,400 acres, within a single selection, only from vacant, unappropriated, nonmineral, surveyed public lands for support in aid of other school sections.

The third approach would be for the State of Utah to exchange state lands for federal lands as authorized by Subsections (c) and (d) of section 8 of the Act of June 28, 1934 (48 Stat. 1272). When lands are exchanged with the state such an exchange is based on a value for value basis rather than acre for acre.

At this time none of the lands in question for either the power plant or townsite would qualify for disposal under a townsite entry. Such a disposal requires that the lands must be occupied by inhabitants prior to filing. These lands do not have occupancy at this time.

Regardless of the approach by which the lands are passed on to the State of Utah, impacts would be the same to the environment as no environmental restrictions could be inserted in the transfer document. The only restrictions of an environmental nature that could be considered are the Kane County zoning regulations, which are limited in scope when applied to a rural society rather than an urban society. Furthermor, no matter how adequate zoning regulations are they are no better than the county's willingness to enforce them.

Kaiparowits Planning and Development Advisory Council

New town

The Kaiparowits Planning and Development Advisory Council (PDAC) selected Call Engineering, Inc., to study feasibility of designs and locations for a new town to meet housing needs related to the proposed project. Call Engineering provided a basic plan, suggested a site on East Clark Bench for primary consideration, and suggested alternatives in planning and location.

Alternatives in planning

Alternatives considered included flexibility in design, alternative water supply, and alternative disposal of treated sewage effluent. Call Engineering suggested that the basic plan be used, but that a developer could modify the plan if needed. Further study of a site and refinement of the plan could provide greater compatibility with terrain and within the town, and help provide adequate housing at appropriate times. The opposite effects could also occur, however, which emphasizes the importance of planning efforts.

Flexibility in planning for the East Clark Bench site includes expansion of the initially defined area to include a state-owned section of land (Section 16, T. 43 S., R. 2 E.). This is intended as a contingency measure, which would permit construction of housing early enough to avoid or reduce disadvantages of hastily constructed living facilities in case of delay in transferring land for a town site. Use of the state land would result in a town that would straddle U.S. Highway 89, and require mitigating measures to reduce traffic problems and hazards. Environmental impacts would be much the same as those of a town oriented entirely north of U.S. 89. Access to a site on state land would require a right-of-way over federal land, which would not be granted in advance of approval of the proposal.

Water would come from deep wells on or near the site. An alternative would be water from Lake Powell, through a 24-inch pipeline from the proposed

power plant water pipeline. It could also become necessary to use subsurface water from wells at some distance from a town site. In either case, construction of a pipeline would require a right-of-way and cause physical impacts which would need to be mitigated. The alternative generating station water pipeline route along the proposed highway would be nearer than the proposed pipeline route to the East Clark Bench site. The municipal water line would, therefore, be shorter if it were connected at the nearest point, thus reducing cost of development.

Treated sewage effluent is proposed to be used for irrigation. Suggested applications include irrigation of pasture crops or the proposed golf course, or disposal in evaporation and percolation ponds. Any of these methods would cause local changes in environment by increasing humidity. Specific impacts would depend on location, disposal method, and amounts of effluent. As these amounts are not known at this time the increase in humidity cannot be quantified.

Call Engineering also mentioned Nipple Bench as a town site. In addition, a fifth alternative, also located on East Clark Bench about seven miles west of the primary proposal, is considered here (see Illustration 38 for location). Figure 17 indicates physical and location characteristics of these sites, all of which are in Kane County. It describes the existing environments, and also provides some data regarding potential conditions if a town were developed at any of the sites. Call Engineering suggested that the town plan for East Clark Bench could be adapted to alternative sites.

Alternate town sites

The PDAC selected three sites as alternatives to the East Clark Bench location. These sites are in Butler Valley, Long Flat, and on Four Mile Bench (see Illustrations 39-42).



East Clark Bench primary townsite

Illustration 38



Butler Valley alternative townsite looking southwest

Illustration 39



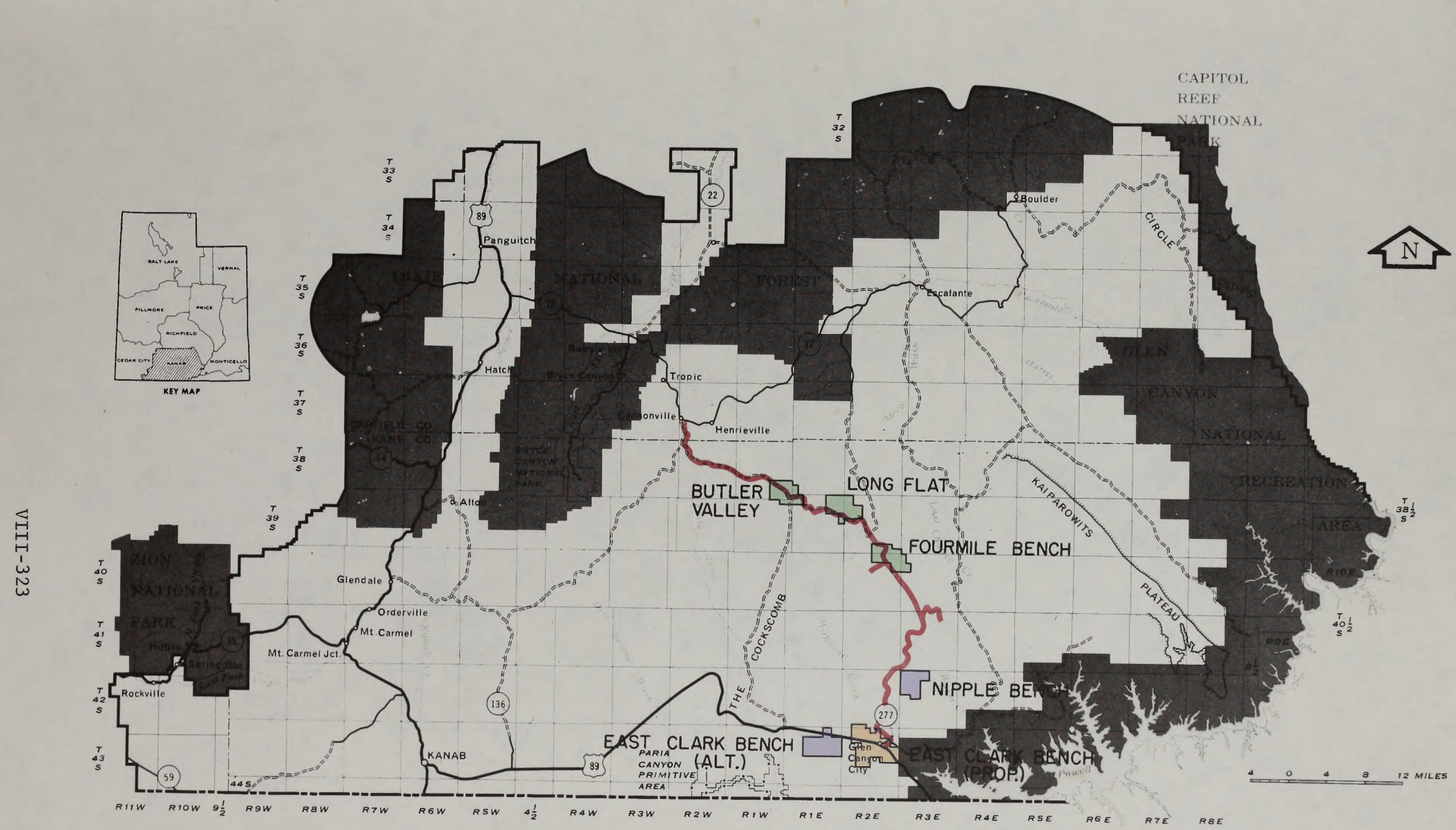
Long Flat alternative townsite. Looking northwest

Illustration 40



Fourmile Bench alternative townsite. Looking south.

Illustration 41



PROPOSED AND ALTERNATE TOWN SITE LOCATIONS

KANAB DISTRICT
1974
UTAH

PROPOSED TOWN SITE

ALTERNATIVE TOWN SITE

ALTERNATIVE TOWN SITE (APPROXIMATE BOUNDARY)

PROPOSED HIGHWAY

ILLUSTRATION 42

FIGURE 17
Characteristics of Proposed and Alternative Town Sites

Factors	East Clark Bench (primary site)	Butler Valley	Long Flat	Fourmile Bench	Nipple Bench	East Clark Bench alternate
Location	T. 42 & 43 S. R. 2 E.	T. 38 & 39 S. R. 1W & 1E.	T. 39 S. R. 1 & 2 E.	T. 39 & 40 S. R. 2 & 3 E.	T. 42 S. R. 3 E.	T. 43 S. R. 1 E.
Approximate acreage proposed for acquisition[a]	8,960	4,800	5,440	5,280	-	-
Average elevation above mean sea level (feet)	4,200	6,300	5,800	6,200	5,200	4,700
Estimated average annual precipitation (inches)	6.3	11-12	10-11	9-10	8-9	6-7
Estimated average January temperature	32°F	27°F	28°F	27°F	29°F	31°F
Estimated average July temperature	82°F	69°F	72°F	70°F	80°F	82°F
Approximate length of frost-free season (days)	180-200	120-140	140-160	140-160	140-160	160-180
Dominant vegetative type	mixed desert Shrub	sagebrush[b]	sagebrush	pinyon-juniper	brush & grass	mixed desert shrub
Soils	sand & sandy loam; minor, scattered gypsum; moderate erosion susceptibility	loam; partly gypsiferous; moderate erosion susceptibility	loamy; fine to medium texture, contains expandable clay, highly erosive	medium texture; shallow; moderate erosion susceptibility	medium texture; shallow, moderate erosion susceptibility	sand & sandy loam; moderate erosion susceptibility

[a]About 2,240 acres would actually be utilized for town development. Larger acreages would be applied to obtain flexibility in arrangement within the selected area.

[b]Presently seeded with crested wheat grass.

(continued)

FIGURE 17 (continued)
Characteristics of Proposed and Alternative Town Sites

Factors	East Clark Bench	Butler Valley	Long Flat	Fourmile Bench	Nipple Bench	East Clark Bench alternate
Sensitive biological features	antelope herd in vicinity			pinyon & juniper 500-700 yrs. old; some more than 1,400 yrs. old		antelope herd in vicinity
Topography & Geology	gentle slope northward; steep sandstone outcrops to the south; deep drainage (Buck Tank Draw) in western portion	broad valley surrounded by hills	broad valley with numerous gulleys	low hills; cliffs surround bench on east, south & west	low hills and mesas; cliffs surround bench on east, south and west	gentle slope northward; steep sandstone outcrops south of site
Mineral resources underlying site	undetermined quantity and quality of gravel	thin, uneconomical coal beds; minor deposits of gravel; gypsum deposits nearby	possibly 60 million tons of coal; some gravel in streams and terraces	about 92 million tons of coal, 1900 feet deep or more	thin, low quality coal 600 feet or more	-
Mineral leasing	oil and gas leases	oil and gas leases	oil and gas leases	oil and gas leases; adjacent coal leases	oil and gas leases	oil and gas leases
Land uses on and immediately adjacent to site	Glen Canyon City; U.S. 89; 230 KV transmission line; cattle grazing (450 AUMs); gravel quarrying; Utah State fish ponds; sightseeing	Cottonwood Canyon road (US 89-Cannonville); 69 KV transmission line; 230 KV transmission line, cattle grazing (800 AUMs); Grosvenor Arch	Cannonville-Fourmile Bench road; cattle grazing (143 AUMs); hunting	livestock and BLM roads; cattle grazing (740 AUMs); hunting; firewood gathering	livestock and BLM roads; cattle grazing (948 AUMs)	U.S. 89; cattle grazing (133 AUMs)

(continued)

FIGURE 17 (continued)
Characteristics of Proposed and Alternative Town Sites

Factors	East Clark Bench	Butler Valley	Long Flat	Fourmile Bench	Nipple Bench	East Clark Bench alternate
Approximate distance to nearest community by existing road (miles)	Glen Canyon City - 0 Page, Arizona - 16	Cannonville-16	Cannonville - 22	Cannonville-30 Escalante - 34	Glen Canyon City - 27 Page, Arizona - 43	Glen Canyon City - 7 Page, Arizona - 23
Approximate distance by proposed highway to						
- Fourmile Bench plant site	30	15	9	2	18	37
- mining area	22	26	20	10	12	29
- Nipple Bench alternate plant site	14	34	28	18	1-2	21
Approximate shortest distance via proposed highway, where appropriate, to						
- Bryce Canyon National Park (headquarters)	70	33	39	46	62	63
- Escalante Canyon Outstanding Natural Areas (14 miles east of Escalante)	80	64	55	48	66	87
- Capitol Reef National Park (west boundary, near Torrey)	138	119	113	106	124	145
- Glen Canyon National Recreation Area (Wahweep Marina)	14	51	53	46	28	21
- Paria Canyon Primitive Area	14	32	38	46	28	7

Location may significantly affect quality of living and desirability of a site. Increased distances from US 89 could lessen the likelihood of attracting additional business and industry, which would affect the longevity of a town in the event the plant and mine shut down. Higher elevation sites would be on the Cannonville-Fourmile Bench road, and would be affected by truck traffic from and to the limestone quarry. Commuting from sites that are farther from the plant site and mining area would require greater use of fuel. Similarly, greater use of fuel and of the proposed highway would occur if large numbers of residents wanted to "get away" on weekends. Higher sites would be less likely to discourage uncontrolled development of private lands along US 89, but they may encourage some economic development in nearby parts of Garfield County through recreational use of federal lands. Distance from a town to the mining area would have more effect on fuel consumption than distance to the generating station, because a larger number of people would be employed in mining.

Restricted possibilities of expansion and the absence of suitable state land for contingency development, if required, could cause difficulties. Need for additional town sites or inability to develop adequate housing early enough, would result in congested and unplanned growth. East Clark Bench and Fourmile Bench sites appear to have the greatest advantages in these respects.

Sites at higher elevations (Butler Valley, Long Flat, and Fourmile Bench) would require energy for heating in winter, whereas sites at lower elevations would require less energy for heating, but would use energy for air conditioning in summer. Cold winters at higher elevation could make those sites less attractive for living.

Emissions from automobile and other engines, space heating, light industry, and sewers would be approximately the same at any site, although a somewhat greater proportion may come from space heating at the higher sites in winter if oil and gas are used as fuels. The likelihood of air pollution,

however, depends on air dispersal characteristics, which in turn depend on such factors as elevation, adjacent terrain characteristics, exposure to winds, and expected frequency of limited dispersion conditions. These factors differ at each alternative site, indicating that dispersion conditions could be different. Alternative town sites have been ranked according to relative likelihood of potential air pollution. That is, sites were compared with each other on the basis of greater or lesser likelihood of dispersion of pollutants.

Town construction at any site would require some excavation and filling. The kind and extent of such preparation would depend on the site and the town plan. In addition, natural surfaces would be replaced to a large extent with impervious surfaces, such as roofs, streets, and parking lots.

Intense, short duration storms would cause rapid runoff and erosion; effects would vary with location, soils, and slopes.

Difficulty in obtaining an adequate water supply and expense of maintaining a system are significant factors which would affect municipal budgets and involve environmental impacts. At sites where an adequate supply of suitable well water is not available, water needs would have to be met by developing a well and pipeline system from the nearest underground source or by piping water from the proposed generating plant supply. Use of generating plant water would require a larger pipeline from Lake Powell to the municipal water supply connection. The community would have sole responsibility to maintain the entire system at an adequate standard after the plant and mine operations cease.

Water rights would have to be obtained, no matter what the source of supply might be. The Lake Powell water service contract does not provide for municipal use, and some negotiations would be necessary for a town to obtain water from the generating station and mine supply system. Water supply from Navajo sandstone may conflict with Lake Powell bank storage or other water rights, and could be challenged.

At all sites most native vegetation within the developed area would be eradicated and native vegetation and wildlife nearby would be eliminated. Non-native plant species may invade the surrounding area. Deer and raptors would be disturbed by human activity on the higher benches, whereas the nearby antelope herd may be eliminated as an indirect result of a town on East Clark Bench.

Little is known about the presence or absence of archaeological, paleontological, and historical values at each of the sites, except for Fourmile and Nipple benches, discussed previously in this statement. Surveys and, if necessary, salvage at any site selected for a town, prior to starting construction, would somewhat offset the loss of any values that might be present. However, the site would be destroyed, and knowledge of its relationship to the surroundings would be lost.

Mineral resources underlying the sites could become unavailable or difficult to recover. Livestock grazing would be eliminated at any of the sites.

National parks, Dixie National Forest, and natural areas to the north would receive greater use if a town were developed on any of the higher sites because of proximity. Glen Canyon National Recreation Area and Paria Canyon Primitive Area would be more affected by a town on Nipple Bench or East Clark Bench. Impacts from recreational use of public lands adjacent to any town site would be as described in Chapter III, but the predominant kinds of activity would vary somewhat with location of the town. Recreation at the higher sites would include increased wood and pinyon nut gathering, and hiking. Water-oriented recreation and off-road vehicle travel would be common near a town on East Clark Bench.

Air pollution may or may not be important, depending on the characteristics of each site and the effectivesness of emission controls. Land use conflicts would be important to utility companies having rights-of-way, to

grazing licensees, town residents, and possibly to mineral developers. Aesthetic and recreational impacts are partly subjective as to their particular significance in each case, but are important to quality of the human environment and, if adverse, are difficult to mitigate. Potential hazards which are adjacent to some of the sites could possibly be mitigated by ordinances, fences, and other measures, but they too would affect quality of living.

A town at any of the alternative sites would involve the following effects when compared with each other and with the primary site, which has been analyzed in preceding chapters and is summarized here for comparison. Items listed are not in any order of importance. Figure 18 is a simplified comparison of site conditions and potential effects.

East Clark Bench (primary alternate)

1. Adjacent to US 89, which would require mitigating measures to reduce traffic hazards. Commuting time to mining area may be reasonable for most residents, but commuting time to Fourmile Bench plant site would be longer than from any other site except the East Clark Bench alternative site.

2. Usable space for expansion is present around the site and there is suitable state land for contingency development.

3. Air conditioning would be a necessity for most residents because of high summer temperatures. Space heating would also be necessary during at least three or four months. Potential for dispersal of air pollutants is probably less than at Fourmile Bench, but better than at Butler Valley.

4. Soils on the north side of US 89, which would bisect the proposed community, are considered to be favorable or exhibit a minor degree of limitation for septic tank fields, sewerage lagoons, dwellings, shallow excavations, sanitary landfill and roads and streets. Good performance and low maintenance costs can be expected from the above mentioned facilities if placed north of US 89.

FIGURE 18
Environmental Comparison of Proposed and Alternative Town Sites

Factors	East Clark Bench (proposed site)	Butler Valley	Long Flat	Fourmile Bench	Nipple Bench	East Clark Bench alternate
Relationship to proposed highway	terminus	adjacent	adjacent	adjacent	near	near
Estimated driving time[a] (minutes, one-way) to:						
- Mining area	29	35	27	13	16	39
- Fourmile Bench plant site	40	20	12	3	24	49
- Nipple Bench alternative plant site	19	45	37	24	b	28
- US 89 (by proposed highway)	-	60	52	43	19	-
Sufficient space for expansion	yes	no	yes	yes	no	yes
Suitable State land available	yes	no	no	yes	no	yes
Conflicts with present and proposed land uses	230 KV transmission line; grazing; proposed 500 KV transmission lines	230 & 69 KV transmission lines; grazing	grazing	grazing	grazing	grazing
Potential conflicts with mineral development	oil and gas leases; bench gravel	oil and gas leases; minor coal, gravel, gypsum	oil and gas leases; minor gravel	oil and gas leases, coal leases in west part - coal at 1,900 ft. or deeper	oil and gas leases, thin, deep coal seams (probably not minable)	oil and gas leases
Strong possibility of adequate subsurface water	yes	no	no	no	no	yes

[a]Assuming an average speed of 45 miles per hour.
[b]There is not enough space on Nipple Bench for both a generating plant and a town.
[c]Based on proximity to vantage points, relative number of viewers, likelihood of blending with background, and natural screenings.

(continued)

FIGURE 18 (continued)
Environmental Comparison of Proposed and Alternative Town Sites

Factors	East Clark Bench	Butler Valley	Long Flat	Fourmile Bench	Nipple Bench	East Clark Bench alternate
Distance to proposed water pipeline from Lake Powel to Fourmile Bench (miles)	8	19	12	2	0	15
Potential aesthetic intrusion[c]	moderate	high	moderate	low to moderate	low	moderate to low
Major potential disturbances	Off-road vehicle disturbance of sensitive Tropic Shale	Grosvenor Arch	-	Mature stand of pinyon-juniper	-	Off-road vehicle vehicle disturbance of sensitive Tropic Shale
Potential hazards	ravine with very steep sides; cliffs to south	-	-	cliffs at edges of bench	cliffs at edges of bench	rocks and cliffs to the south
Relative rank of sites for potential air pollution (1 = greatest probability 5 = least)	2	1	4	5	3	2

Soils south of US 89, within the immediate vicinity of Glen Canyon City, Utah, contain intrusions of gypsum deposits. Where gypsum deposits occur soils have moderate limitations for septic tanks, sewerage lagoons, dwellings, shallow excavations, sanitary land fill and roads and streets because of soil instability and the potential for high shrink-swell ratio. This limitation can be overcome or modified by special planning, design or increased maintenance costs (see Appendix II-4 for a detailed description for soil limitation ratings).

5. Withdrawal of water from Navajo sandstone to supply a new town would increase six-fold over the 1974 rate of withdrawal, and could affect the flow of Wahweap Creek. Disposal of sewage and solid waste on porous sandstones in the area could contaminate sub-surface water, including the town's water supply. Water obtained from Lake Powell would require a pipeline, probably connected to the generating station water supply line, and would involve additional expense and impacts. The line would have to cross Wahweep Creek Canyon, and would either be visible or, if buried, might be broken by floods.

6. All vegetation, except perhaps in open space buffer zones, would be eradicated. The presence of so many people on East Clark Bench would probably lead to elimination of the small antelope herd in the vicinity.

7. The site is traversed by a 230 kv line, and the proposed 500 kv transmission corridor would cross the site, creating conflicts in land use. Grazing rights for up to 450 animal unit months would be lost at the site itself. Unknown amounts of bench gravel would become unrecoverable unless mined prior to town development.

8. A town would disturb scenic qualities, although disturbance would not necessarily be adverse to all viewers, especially if mitigated by planning and development and enforced ordinances.

9. Rock outcrops and a deep ravine within the site are potential hazards.

Butler Valley

1. Butler Valley is adjacent to the proposed highway, but the time required for commuting to the mine, Nipple Bench alternative site, and US 89 could make the site undesirable to many potential residents, although it is relatively close to the proposed Fourmile Bench plant site (see Figure 18). The site is farther from US 89 than any other alternative, and this would discourage any economic growth that might be dependent on supply from the south. Nevertheless, the site is the closest to Garfield County and could induce some economic benefits in the Cannonville area. Location on the proposed highway would result in some traffic and noise problems from limestone delivery trucks from the proposed quarry.

2. A relatively small amount of usable space is available for expansion, and there is no suitable state land for contingency development included in the site.

3. Relatively cold winters would require space heating, but air conditioning would be optional. The site has potentially the poorest air pollution characteristics of any site. No studies have been performed, however, to determine whether air pollution would actually be a problem.

4. Soils consist primarily of alluvial fill with intrusions of gypsum. Where gypsum is lacking soils are considered favorable or exhibit a minor degree of limitation for septic tank fields, sewerage lagoons, dwellings, shallow excavations, sanitary landfill, and roads and streets. Good performance and low maintenance costs can be expected from the above mentioned facilities. However, where gypsum deposits occur soils have moderate limitations for septic tanks, sewerage lagoons, dwellings, shallow excavations, sanitary landfill and roads and streets because of soil instability and the potential for high shrink-swell ratio. This limitation can be overcome or modified by special planning, design or increased maintenance costs. (See Appendix II-4 for a detailed

description of soil limitation ratings.)

5. This site has a questionable potential for subsurface water supply. It might be necessary to obtain Lake Powell water through the power plant water pipeline. This would require an increase in the diameter of the proposed pipeline from Lake Powell to Fourmile Bench. This system would be longer than for any other town site (19 miles), and the most expensive to maintain if the power plant was eventually shut down. It would also involve the most environmental disturbance because of length and the necessity to cross ridges east of Butler Valley.

6. Part of the site is presently traversed by 230 kv and 69 kv transmission lines; this would be a conflict in land use. Up to 3,000 acres of land cleared by BLM and seeded with crested wheatgrass to increase grazing capacity, would be lost. Grazing rights for 800 animal unit months would be terminated. Relatively minor deposits of coal, gypsum, and gravel could become non-recoverable.

7. A town at Butler Valley would be the most likely to disturb scenic qualities, and be the most visible from vantage points such as Rainbow Point in Bryce Canyon National Park. Scenic qualities of the site may attract residents, somewhat offsetting the fact that winter months may be too cold to suit many residents.

Long Flat

1. This site is also adjacent to the proposed highway, with potential for impacts due to limestone truck traffic, but it is closer than Butler Valley to the proposed plant and mine sites, Nipple Bench, and US 89. A town at Long Flat may be less likely than a town at Butler Valley to stimulate growth in Garfield County.

2. Usable space is available for town expansion, but no usable State land for contingency development is included in the site.

3. Cold winters would require space heating, but air conditioning may be unnecessary. Like Fourmile Bench, Long Flat has relatively good likelihood for dispersal of air pollutants.

4. Soils in Long Flat have moderate limitations for septic tank fields, sewerage lagoons, shallow excavations, dwellings, sanitary landfill and roads and streets due to either slopes in excess of eight percent along the edges of Long Flat or due to soils with low permeability and a high shrink-swell ratio in alluvial bottoms. This limitation can be overcome or modified by special planning, design or increased maintenance costs. (See Appendix II-4 for a detailed description of soil limitation ratings.)

5. The potential for adequate subsurface water is questionable. The same conditions for using water from Lake Powell would apply as at Butler Valley, except that municipal water pipeline length would be about seven miles less, and cost of maintaining the system should therefore be less. If the generating station was located at Nipple Bench, the nearest point from which to obtain Lake Powell water would be from the pipeline to the mine. In this case, the municipal supply pipeline would need to be about 21 miles long.

6. Small amounts of gravel in creek bottoms could be lost unless removed prior to development. Grazing for 143 animal unit months would be excluded.

7. A portion of the site may be visible from Rainbow Point in Bryce Canyon National Park.

Fourmile Bench

1. Fourmile Bench is adjacent to the proposed highway and closest of all sites to the mining area and proposed plant site. It is relatively close to Nipple Bench alternate plant site. The site is somewhat isolated from US 89, but closer than Butler Valley and Long Flat. This site may be the most centrally

located with respect to potential coal-based projects in the Kaiparowits area. If the plant was built at Nipple Bench, a town at Fourmile Bench would be on the limestone truck route, with associated noise and traffic impacts.

2. Sufficient usable space is available to allow future expansion. Usable state land is included in the site for contingency development, but its use prior to transfer of land for a town site would require a right-of-way.

3. As at the other high, northern sites (Butler Valley and Long Flat), space heating would be needed in winter, but air conditioning may not be.

4. Soils on Fourmile Bench are favorable or exhibit a minor degree of limitation for shallow excavations, dwellings without basements, area-type sanitary landfill and roads and streets. Good performance and low maintenance costs can be expected from the above mentioned facilities. However, due to shallow soil cover on Fourmile Bench these soils would be unfavorable for such uses as dwellings with basements, trench-type sanitary landfill, and as a source of cover material for area-type sanitary landfill.

These soils would have moderate limitations for septic tanks, due to low soil permeability, and for sewerage lagoons, due to slope. These limitations can be overcome or modified by special planning, design or increased maintenance costs. (see Appendix II-4 for a detailed description of soil limitation ratings).

5. Subsurface water supply would probably be insufficient and a relatively short pipeline, about two miles in length, would be necessary to use Lake Powell water. If the generating station was built at Nipple Bench, the pipeline would have to be at least 13 miles long. A more feasible supply system would be a seven mile pipeline from the mine supply system, but the mine pipeline would need to be about three times the proposed diameter of eight inches.

6. The mature stand of pinyon and juniper at the site would be adversely affected by construction of a town. Although careful planning and development could preserve many trees to act as noise, wind, and visibility

buffers, the probability of firewood gathering, which might eventually include damage of live trees, could offset any mitigating measures. Most or all of Fourmile Bench would cease to be deer habitat.

7. The potential impacts on archaeological and paleontological values would be similar if a generating station or town were built on Fourmile Bench. However, it is likely that many town residents would hike all over Fourmile Bench, and that all archaeological and surface paleontological values which may exist would be lost.

8. Town construction could preclude mining of coal seams that underlie Fourmile Bench at depths of about 1,900 feet. Part of the western portion of the site is on the El Paso Natural Gas coal lease. Grazing would also be lost (740 AUMs).

9. The site is immediately adjacent to the proposed plant site, which may detract from the quality of living at that location.

10. Cliffs that bound Fourmile Bench a few miles to the east and west are potential hazards.

Nipple Bench

1. Nipple Bench is near the proposed highway and only a few minutes driving time from Fourmile Bench, the mining areas, and US 89.

2. There is insufficient usable land available for both a power plant and a town. Expansion of a town would be limited by the size of the bench. No usable state land is available for contingency development.

3. Both space heating and air conditioning would probably be needed. Windiness may be an undesirable trait, and exposure and soil characteristics may tend to make dust a problem. However, there is relatively small likelihood of air pollution due to the presence of a town.

4. Soils on Nipple Bench are favorable or exhibit a minor degree of limitation for septic tank fields, shallow excavations, dwellings, sanitary

landfill, and roads and streets. Good performance and low maintenance costs can be expected from these facilities. These soils have moderate limitations for sewerage lagoons due to slope in excess of three percent. This limitation can be overcome or modified by special planning, design or increased maintenance costs. (See Appendix II-4 for a detailed description of soil limitation ratings.)

5. Subsurface water supply may be insufficient, but the site is on the proposed power plant water pipeline, and tapping the generating station water supply system would be less expensive and result in fewer impacts than at any other alternative town site.

6. All grazing would be eliminated (948 AUMs). No known mineral values would be made unrecoverable.

7. Archaeological values that have been found on Nipple Bench would be lost, along with others that may exist, unless surveys and salvage could recover them.

8. A town would not be visible from most vantage points, but the view from the town would be limited to the nearby skyline and the edges of benches to the north.

9. Cliffs that surround Nipple Bench to the east, south, and west at short distances from any possible town site are potential hazards.

East Clark Bench (secondary alternative)

1. This alternative is adjacent to US 89, but is the farthest of all sites from Fourmile Bench plant site and mining area. It is less than 30 minutes driving time from Nipple Bench alternative plant site, however. If the town was developed on both sides of US 89, measures would be required to reduce potential traffic hazards.

2. It may be less likely than the primary site to become economically diversified, because it would not be at the junction of US 89 and the proposed highway.

3. Sufficient usable space is present for considerable expansion. Usable state and private lands for contingency development are nearby.

4. As at the primary site on East Clark Bench, air-conditioning would be necessary for most residents at this site. Likelihood of air pollution is also probably less than at Butler Valley but greater than at Fourmile Bench.

5. Soils lying on both sides of U.S. Highway 89 are considered to be favorable or exhibit a minor degree of limitation for septic tank fields, sewerage lagoons, dwellings, shallow excavations, sanitary landfill, and roads and streets. Good performance and low maintenance costs can be expected from the facilities if placed in this area. (See Appendix II-4 for a detailed description of soil limitation ratings.)

6. If sufficient subsurface water is not available on or near the site, a pipeline from the power plant water supply line would be up to seven miles longer than at the primary site.

7. The nearby antelope herd would probably be eliminated.

8. As at other sites, grazing (133 AUMs), would be eliminated. There are no known mineral resources which could become unrecoverable. This site would avoid the incompatibility at the primary site with the existing 230 kv transmission line and the participants' preferred 500 kv transmission line routes.

9. Rock outcrops to the south are potential hazards.

Mitigating measures

No specific mitigating measures have been proposed for the alternative sites. In general, mitigating measures suggested for the proposed site would be applicable at any alternative site, but some variations may be required according to locality. Most mitigating measures would depend on the town developer and on passage and enforcement of appropriate and applicable ordinances. Because land would be transferred out of federal ownership, federal agencies would not have jurisdiction in town.

Unavoidable adverse effects

Grazing, natural vegetation, and wildlife would be eliminated in the developed area at any site, and would be eliminated or affected over a surrounding, larger area, depending on decisions of livestock operators and behavior of new town residents. Mineral resources would become unrecoverable, unless mined prior to town construction, and exploration for mineral resources would be precluded. Any cultural (archaeological and historical) values which may be present at any of the sites would be lost, unless salvaged prior to construction. Degree and nature of these adverse effects would vary with each site according to the environmental characteristics and present use of land as indicated in Figure 17.

Summary

A town at any of the higher sites (Butler Valley, Long Flat, and Fourmile Bench) would result in greater overall environmental disturbance, except to antelope, and be more expensive to maintain than a town at the lower sites. Long Flat and Fourmile Bench would be better located with respect to the proposed generating plant and mining area and would have lower potential for air pollution than sites on East Clark Bench, however. A town on Nipple Bench would result in relatively less environmental disturbance than a town at the higher sites, but would be restricted in possibilities of growth and would be more isolated than a town on East Clark Bench. The alternative site on East Clark Bench would be similar in most respects to the proposed site with regard to environmental considerations, but would be less convenient for commuting to mine and generating plant.

No transfer of land for town development

If a sufficient area of land is not transferred for town development, the result would be scattered, more or less independent housing on private and state lands and abrupt growth of nearby communities such as Page, Glen Canyon City, and Cannonville. Within about 35 miles of Fourmile Bench and the mining

area, near the proposed highway, there are about 16,000 to 17,000 acres of private and state land. Except for the area around Cannonville and Kodachrome Basin State Park, however, none of this land is in parcels larger than 640 acres. Some of these sites would not be suitable for housing because of rough terrain or lack of access, so the total that could potentially be used is less than 16,000 acres.

Control of such developments would be difficult. Sewage and solid waste disposal and water supply would be scattered and present significant adverse health problems. Expansion of any site would be severely limited. Services and facilities in existing communities would be strained. Small tract disposal by the federal government would have relatively few mitigating values, and would not prevent the kinds of impacts cited for the proposed and alternative town sites. Impacts would be cumulative over a large area. Trespass on federal lands for additional housing space could occur.

New highway

The Kaiparowits Planning and Development Council, through its Access - Highways Work Group, has been studying and developing alternatives for an access system related to the Kaiparowits Power Project. The work group submitted its formal recommendations to the planning and development council for consideration and approval November 18, 1974.

The planning and development council and executive committee approved the recommendations of the work group November 18, 1974.

It is the basic action proposal of the Planning and Development Council that:

> "The Access - highways system planned and constructed to support the Kaiparowits Power Project and proposed New Community should be a 'through system' from Cannonville in Garfield County (on the North) to the Glen Canyon City (East Clark Bench - New Community Site) on the south - US 89."

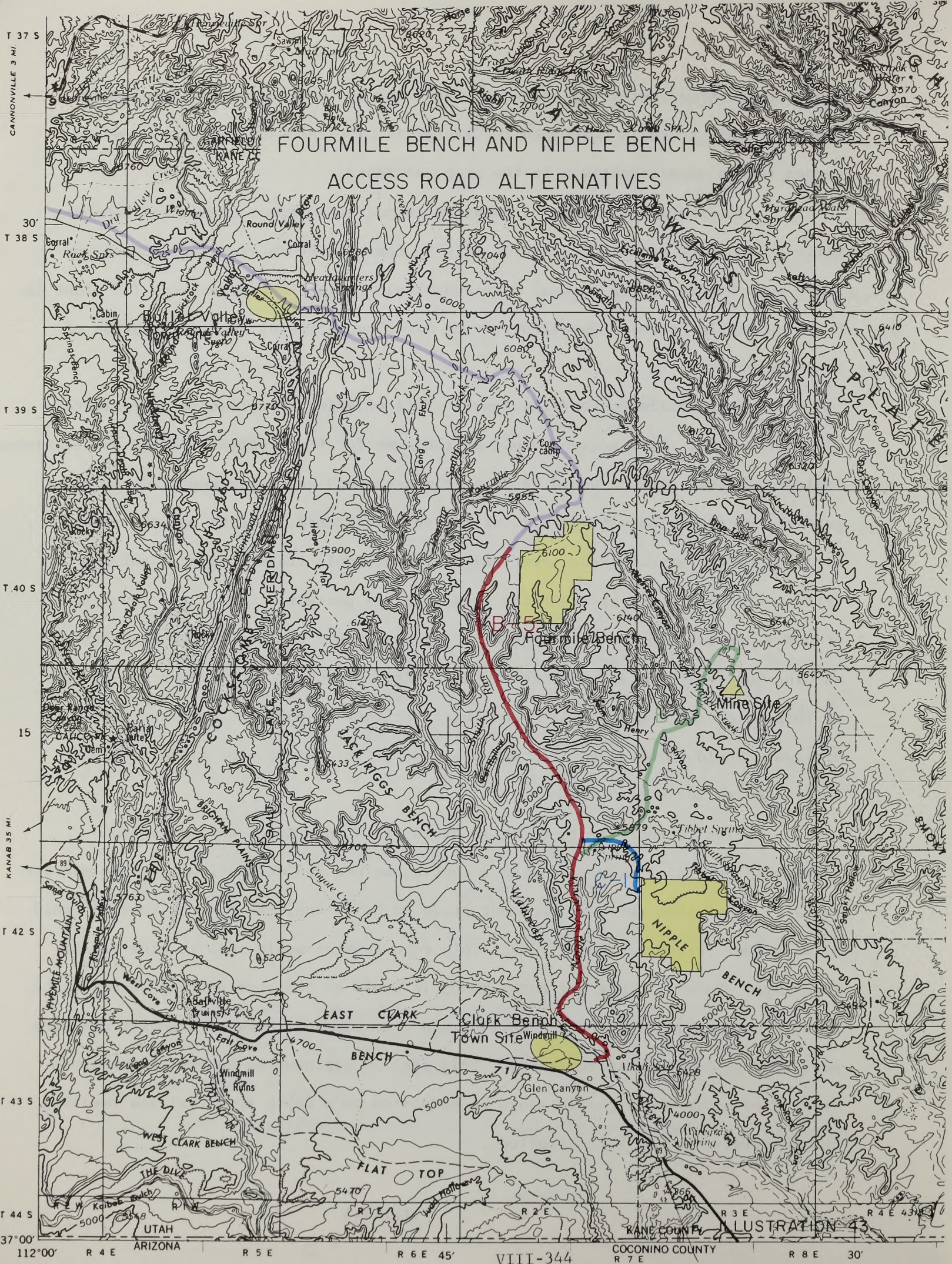
Four road systems were studied as possible routes for the new highway.

One of these four routes was chosen by the Kaiparowits Planning and Development Council. This route is described in Chapter I. The three routes that were not chosen remain as alternatives to the proposed route.

Alternative I - This alternative is made up of four segments: Cannonville to Fourmile Bench; Glen Canyon City to Fourmile Bench via Nipple Creek and Smith Run; Nipple Spring to Coal Mine and Nipple Spring to Nipple Bench (if plant is built on Nipple Bench). See Illustration 43. The following is a description of these segments.

Cannonville to Fourmile Bench - This existing dirt road is approximately 29.8 miles long. This segment would be the same for the proposal and all alternatives Included in this segment would be 39 stream crossings and a maximum grade of eight percent for approximately one mile of the total distance. Except for the few sections of eight percent grade, vertical alignment would traverse gently rolling terrain with all other grades being less than six percent. One of the few areas of heavy construction on this segment of highway would be through the area known as "The Gut" which is adjacent to Grosvenor Arch. Geologic formations are steeper at this point and would require some short sections of moderate cuts and fills. Aggregate could be obtained from Wahweap Creek, Paria River, the hills of Round Valley and on Horse Mountain.

Glen Canyon City to Fourmile Bench via Nipple Creek and Smith Run - This would be a 25.2 mile road with a continuous one and one-half mile seven percent grade. Other than the seven percent grade in Smith Run, the general terrain would allow a four percent grade or less. This road segment would require nine stream crossings. Wahweap Creek and Horse Mountain would be the best sources of aggregate. A short section in Nipple Creek would contain an exposed shale layer which has very poor road building characteristics. This shale would have to be kept as moisture free as possible and probably would be excavated to a depth such that its swelling characteristics could be controlled.


FOURMILE BENCH AND NIPPLE BENCH
ACCESS ROAD ALTERNATIVES
B-5
Fourmile Bench
Mine Site
NIPPLE BENCH
Clark Bench
Town Site
EAST CLARK BENCH
WEST CLARK BENCH
FLAT TOP
THE DIKE
Butler Valley
Round Valley
Headquarters Spring
Glen Canyon
Adairville Twins
Windmill Ruins
Calico Peak
Coyote Valley
Kaibab Gulch
Coyote Gulch
Wildhorse Gulch
Tibbet Spring
Henry Canyon
Fourmile Canyon
Nipple Canyon
Smoky Hollow
Escalante Canyon
Pleasant Canyon
Deer Trail Canyon
Water Canyon
Long Canyon
Last Hollow
Cow camp
Corral
Cabin
Windmill
Spring
Tank
Trail
Creek
Valley
Canyon
Bench
Ridge
Mesa
Butte
Point
Rock
Rocky
Hill
Knoll
Flat
Top
Dike
Gulch
Wash
Draw
Fork
Cove
Pass
Peak
Mountain
Hollow
Divide
Slope
Plateau
Cliffs
Escarpment
Basin
Valley
Lake
Reservoir
Dam
Ruins
Windmill
Corral
Cabin

Nipple Spring to Coal Mine - This segment would be 12.9 miles in length. Road grades would be less than three percent and 16 stream crossings would be included.

Nipple Spring to Nipple Bench - This road segment would be approximately 3.9 miles long, with no grades steeper than four percent. This segment would contain no stream crossings. Aggregate would be brought from Wahweap Creek.

The total length of this route would be 67.9 miles not counting the 3.9 miles to the Nipple Bench Site and would require approximately 874,000 cubic yards of aggregate. The 3.9 mile segment to Nipple Bench would require approximately 46,800 cubic yards of aggregate.

Impacts to the environment would be the same as those identified in Chapter III.

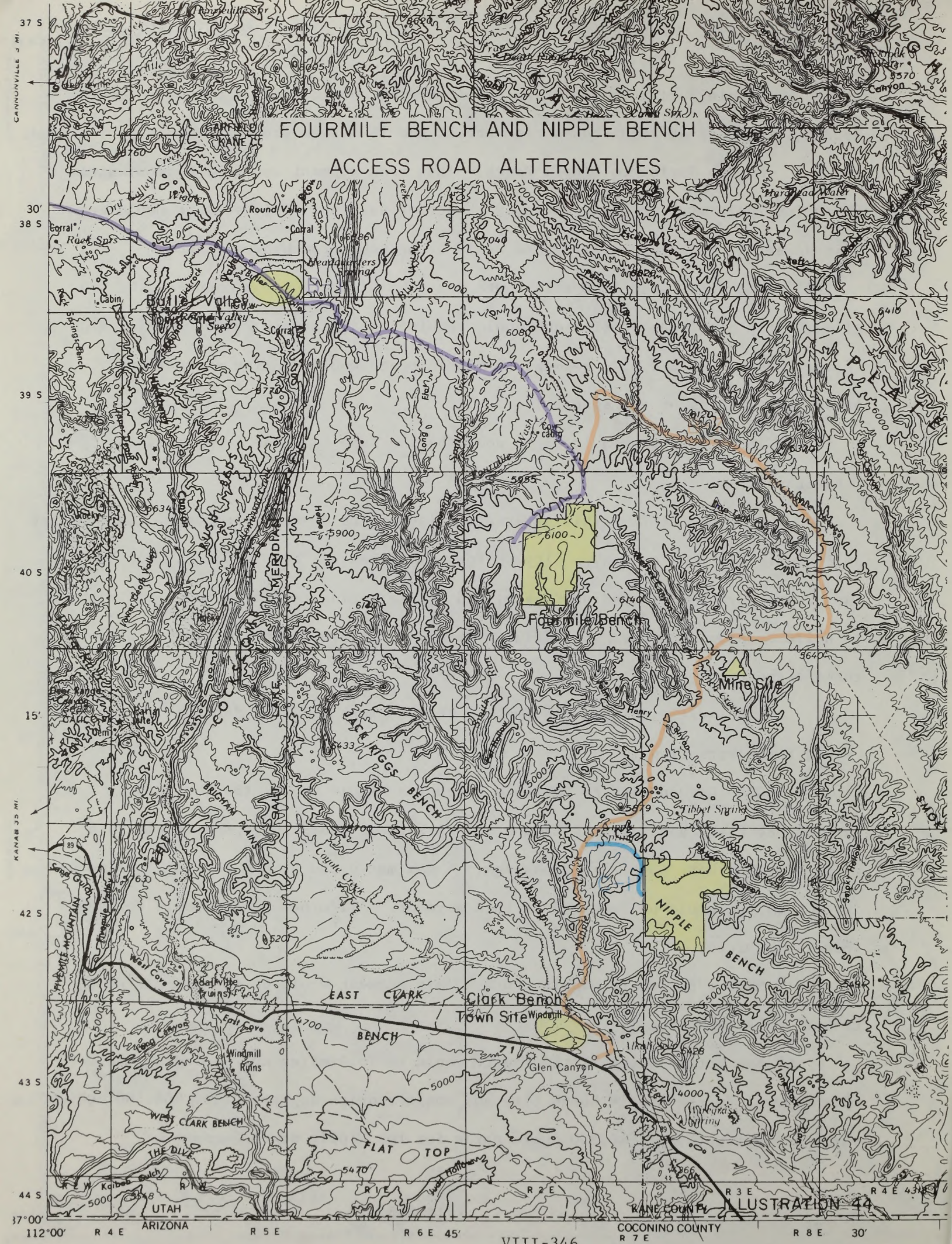
Alternative II - This alternative is made up of three segments: Cannonville to Fourmile Bench; Glen Canyon City to Fourmile Bench via Nipple Creek, Coal Mine, Last Chance Creek and Paradise Canyon; and Nipple Spring to Nipple Bench (if plant is built on Nipple Bench). See Illustration 44. The following is a description of these segments:

Cannonville to Fourmile Bench - This segment would be the same as described for Alternative I.

Glen Canyon City to Fourmile Bench via Nipple Creek, the Coal Mine, Last Chance Creek and Paradise Canyon - This segment would be approximately 45.6 miles long and have 43 stream crossings. A maximum grade of 6.8 percent continuous for 1.4 miles, would be required on this segment. All other grades would be less than five percent.

Nipple Spring to Nipple Bench - This segment would be the same as described for Alternative I.

The total length of this route would be 75.4 miles not including the 3.9 mile segment to the Nipple Bench Site and would require approximately 964,800 cubic yards of aggregate, and 46,800 cubic yards for the Nipple Bench Segment.


FOURMILE BENCH AND NIPPLE BENCH
ACCESS ROAD ALTERNATIVES
Fourmile Bench
Mine Site
Clark Bench
Town Site
NIPPLE
BENCH
EAST CLARK
BENCH
WEST CLARK BENCH
JACK RIGGS BENCH
FLAT TOP
THE DIVIDE
Butler Valley
Round Valley
Meadquarters Springs
Windmill Ruins
Glen Canyon
Tibbet Spring
Adairville Ranch
Fall Cove
Wall Cove
Coyote Creek
Long Canyon
Kaibab Gulch
Water Canyon
Escalante Canyon
Paria Canyon
Smoky Hollow
Rock Springs
Corral
Cabin
Tank
Windmill
Ruins
UTAH
ARIZONA
KANE COUNTY
COCONINO COUNTY
ILLUSTRATION 44
37 S
38 S
39 S
40 S
42 S
43 S
44 S
30'
15'
37°00'
112°00'
R 4 E
R 5 E
R 6 E 45'
R 7 E
R 8 E 30'
R 1 W
R 1 E
R 2 E
R 3 E
R 4 E 43'
CANNONVILLE 3 MI
KANAB 35 MI

This alternative would result in 12 percent more sediment deposition in Lake Powell than would the proposed route because of the greater amount of areas that would be disturbed and occupied by the highway and increased need for road aggregate. Also the currently undisturbed areas of Last Chance Creek would be opened to public access and resident deer and cougar could suffer from the pressure of recreationists.

Alternative III - This alternative is made up of three segments: Cannonville to Fourmile Bench; Glen Canyon City to Fourmile Bench via Warm Creek, coal mine and Wesses Canyon; Warm Creek to Nipple Bench via Tibbet Canyon (if plant is built at Nipple Bench). See Illustration 45.

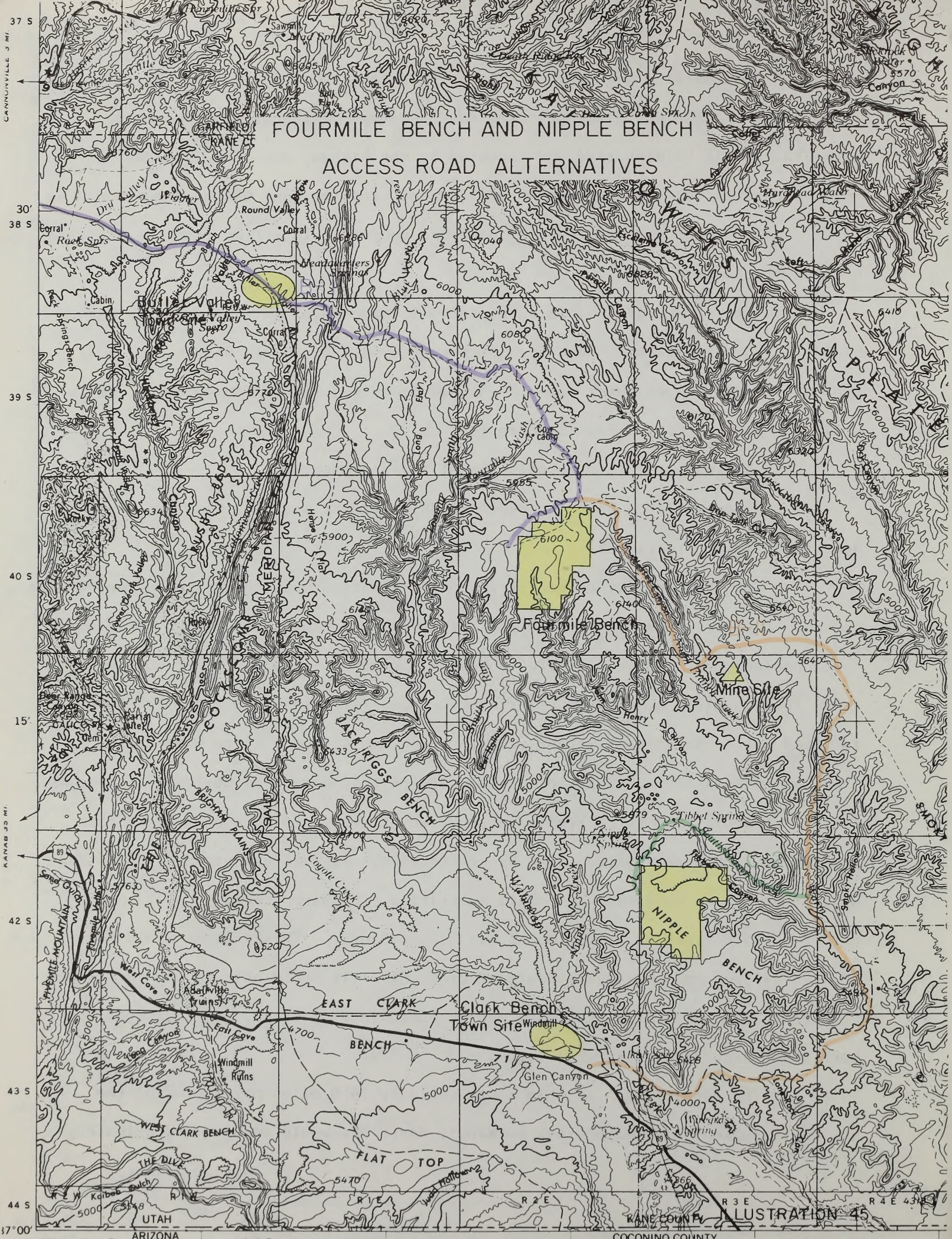
The following is a description of these segments;

Cannonville to Fourmile Bench - This segment would be the same as described for Alternative I.

Glen Canyon City to Fourmile Bench via Warm Creek, the coal mine and Wesses Canyon. This would be a 41.2 mile road with eight stream crossings and a 7.5 percent continuous grade for 0.7 mile in Wesses Canyon plus a six percent continuous grade for 1.5 miles at the top of Missing Canyon. An exposed layer of Tropic shale is found quite extensively in the section from Glen Canyon City to Warm Creek. This shale has a high-shrink-swell ratio resulting in poor road building characteristics and would need to be kept moisture free or excavated to such a depth that its swelling characteristics could be neutralized. Aggregate sources would be Wahweap Creek, Horse Mountain, and small quantities from Warm Creek.

Warm Creek to Nipple Bench via Tibbet Canyon - This segment would be 10.3 miles long and contain five stream crossings. It would have no grades steeper than three percent. Some aggregate can be found in Warm Creek, but additional would have to be brought from Wahweap Creek.

The total length of this route would be 76.0 miles not including the 10.3 mile segment from Warm Creek to Nipple Bench and would require approximately


FOURMILE BENCH AND NIPPLE BENCH
ACCESS ROAD ALTERNATIVES
Fourmile Bench
Mine Site
NIPPLE BENCH
Clark Bench Town Site
EAST CLARK BENCH
WEST CLARK BENCH
FLAT TOP
Butler Valley
Round Valley
Meadow Valley Springs
Adairville Ruins
Windmill Ruins
Glen Canyon
Coconino
Kaibab
Moenkopi
Chinle
Shinarump
UTAH
ARIZONA
KANE COUNTY
COCONINO COUNTY
ILLUSTRATION 45

912,000 cubic yards of aggregate. The 10.3 mile segment to Nipple Bench would require approximately 123,600 cubic yards of aggregate. Disturbance to vegetation and soils would increase by 23 percent compared to the proposed route. Also, erosion characteristics of the Tropic shales and the increased surface disturbance could increase the sediment deposition into Lake Powell by as much as 25 to 30 percent per year above that of the proposed route. This could have an adverse impact to the aquatic habitat. The segments through Warm Creek and Missing Canyon would also be highly susceptible to flash flooding from summer storms.

ALTERNATIVE MEANS OF MEETING PROJECT OBJECTIVES

Purchase power from outside Kaiparowits market area

Assuming availability of transmission facilities, purchase of power from another area would be possible only if utilities had surpluses or were willing to add capacity for the purpose of providing power to the Kaiparowits market area.

All utilities are facing problems of siting and financing generating facilities for their own needs. Therefore, this probably would not be a practical alternative.

Natural Gas

Use of natural gas would reduce air pollution and might allow siting of the plant near the market area with consequent reduction of adverse environmental impacts. However, in light of nationwide concern over availability of natural gas this would not be a workable alternative. The United States has been consuming natural gas faster than discovery of sources (FEA, 1974).

Oil

Use of oil would permit siting of the plant nearer the market areas, but national shortages preclude use of this fuel as an alternative. The United States imports 35 percent of its daily consumption (FEA, 1974).

Nuclear power

All utilities participating in the Kaiparowits project are also participants in various nuclear power plant projects:

Southern California Edison

San Onofre I: 344 mw (80% of 430); 1968
" " II and III; 1,824 mw (80% of 2,280)
approx. 1980

San Diego Gas & Electric

San Onofre I, 86 mw (20% of 430 mw); 1968
" " II and III; 456 mw (20% of 2,280 mw)
approx. 1980

Arizona Public Service

Arizona Nuclear I; 357 mw (28.1% of 1270 mw); 1981
" " II; 357 mw (28.1% of 1270 mw); 1983
" " III; 357 mw (28.1% of 1270 mw); 1984

Salt River Project

Arizona Nuclear I; 357 mw (28.1% of 1270 mw); 1981
" " II; 357 mw (28.1% of 1270 mw); 1983
" " III; 357 mw (28.1% of 1270 mw); 1984

Decision to construct coal over nuclear depends upon evaluation of various economic, technical and environmental factors and the time at which evaluation is made. In this case, the choice was dictated by availability of coal, participating utilities' policies to reach what they consider a proper balance between nuclear and fossil fuels, and their uncertainties in scheduling nuclear generating stations. However, nuclear power plants are a definite alternative to coal-fired plants.

Nuclear power plants, unlike fossil fuel plants, do not emit products of combustion such as particulates, sulphur oxides, and nitrogen oxides. However, they do produce radioactive emissions that release must be strictly limited if adverse affects to health of humans and other biota are to be avoided.

Operation of a light-water reactor plant would generate considerable amounts of waste heat due to comparatively lower thermal efficiency (around 33% compared to 40% for new coal-fired fossil-fueled thermal plants). Effects of this waste heat would depend upon cooling method used and location of the plant.

Use of cooling ponds would produce less forced evaporation than wet cooling towers, but haze, fog, cloud, and ice formation would still occur during periods of sub-freezing temperatures.

Operation of nuclear plants poses some risk of accidents. Plants are designed to withstand a design basis accident, defined as the worst malfunction considered to have a probablility of occurrence high enough to warrant corrective action. For light-water reactors, the worst design basis accident considered is usually a major rupture in the primary cooling system. Maximum radiation dose which could be received at the site boundary, if such an accident were to occur, is est-

Development of geothermal resources entails construction of access roads and well sites, drilling and testing of wells, conveyance of steam over short distances to electric power plants and by-product processing plants, construction of electric power plants, by-products facilities, electrical transmission lines, and facilities for disposing of waste liquids.

Land would be pre-empted or restricted from uses such as wildlife habitat, recreational use, grazing, etc. Terrain would be modified through construction of roads, wells, pipelines, and industrial facilities. Noise and noxious gas emissions could pose problems during testing and production. Possible adverse effects include land subsidence due to removal of fluids and increased seismicity due to reinjection of fluid wastes into producing zones.

Additional impacts associated with geothermal energy are discussed in the final environmental impact statement of the "Geothermal Leasing Program" prepared by the U.S. Department of the Interior, 1973. It is also discussed in Bureau of Land Management's "Energy Alternatives and Their Related Impacts", 1975.

Solar Energy

Several applications for use of solar energy are under development. Among them are: solar water heating, swimming pool heating, home heating, solar baking, solar distillation, solar power plants, solar furnaces, solar pumps and turbines.

Among potential applications of solar energy, residential heating and cooling has the greatest possiblity of sucess. Solar water heating has been used in southern Florida, although less extensively in the past because of availability and low cost of natural gas. Solar space heating and cooling is not as advanced as solar water heating. However, there is an increased trend toward this use in many new homes and buildings in the West.

Another potential application of solar energy is use of thermal gradients to extract solar energy stored in surface layers of the ocean. The summer sun melts polar ice and the cold water moves to the depths of the ocean and flows toward the

equator. Above the cold deep water, surface layers in the tropics remain at a temperature above 80° F. This difference in water temperature can be used to generate electricity.

At the University of Massachusetts, Amherst, William Heronemus and his colleagues are preparing preliminary designs for a submerged power plant in the Gulf Stream. One proposed site is the western edge of the Gulf Stream about 16 miles from Miami. The concept now being considered is a modular design with six turbines in each of two hulls, hooked together. The station would generate about 400 mw of electricity.

Solar power has great potential for supplying at least part of the projected demand. It is an ideal approach because it uses an energy source that is inexhaustible and emission free. Development of this energy source has been given little attention and proven technology for large scale commercial application is limited. Therefore, it is questionable if solar energy would be a feasible alternative in the immediate future for meeting the project objective of generating 3,000 mw of electricity.

Primary impacts from use of solar energy would be negligible. However, a beneficial secondary impact could be a reduction in conventional energy forcast demands, which in turn could possibly reduce need for new thermal generating facilities.

Investments in energy conservation services

Projected growth based on past performance.

During the past three years attention has been given to energy conservation as a means of either delaying or regulating construction of new electrical generating plants. This concern has been discussed in the Ford Foundation's Energy Policy Project Study and the American Association for the Advancement of Science's publication "Energy: Use, Conservation, and Supply".

Before one can assess consequences of energy conservation, projected growth as based on historic growth of electric generation must be identified.

Figure 19 identifies the rate of annual growth in electrical generation for each of the participants and number of times electrical generation could grow based on national trends (Freeman, 1974).

FIGURE 19

Comparisions of Participants' Projected Annual Rate of Growth and the Growth Increase for Selected Years as Compared to the National Average

	Percent of Annual Rate of Growth			Number of Times Electrical Generation Could grow by:	
	1975-1979	1980-1985	1986-2000	1985 or 2000	
Southern California Edison[a]	4.7	4.7	4.7	1.6	3.2
Arizona Public Service[a]	7.3	5.9	5.9	1.9	4.4
San Diego Gas & Elec[a]	8.4	6.5	6.5	2.0	5.2
Salt River Project[a]	6.75	6.75	6.75	1.9	5.1
Average of Participants	6.8	6.00	6.00	1.8	4.4
National[b]	6.0	6.0	5.1	1.8	3.8

a Developed from F.E.A. Report in Appendix I-1
b Developed from Ford Foundation's Energy Policy Project (Freeman, 1974)

Projected growth of electrical energy generation according to past history, at least from a national standpoint, is based on the premise that the number of households will increase 50 percent and industrial use will increase by 25 percent by the year 2000 (Freeman, 1974). It is also assumed that Gross National Product will increase 3.6 percent per year until 1985 and 3.3 percent per year until the year 2000.

For the growth of electrical energy generation to proceed as it has in the past, there is a need for a Federal Government committment towards a strong research and development effort. This effort would be essential to support the present potential of new energy supplies, more productive coal mining techniques and nuclear breeder reactors. Rapid growth of nuclear power would be essential to maintain growth based on historical projection. Unsolved environmental problems such as air pollution, reclamation of surfaced mined lands and uncertain nuclear risks would have to be accepted with the hope they would be solved in a reasonable length of time.

It is doubtful that the present rate of electrical energy generation growth could be maintained as limitations in skilled labor, heavy equipment, available water supply and available financing, would develop (Freeman, 1974). The problems with financing and water supplies would require federal authority and financing to help industry develop energy. The Energy Policy Project of the Ford Foundation does not agree that governmental policies and actions necessary to maintain electric growth are desirable. Also, energy self-sufficiency on a national level by 1985 would not be possible if electrical energy growth maintained its present rate.

Energy conservation by application of technology

One means of off-setting problems created by unchecked electrical energy growth would be to use electrical energy more efficiently by application of technology that is either available or soon will be. Such applications would be;

(1) Remodel old, inefficient electric generators and peaking generators to make them more efficient. Ironically, pollution control equipment reduces efficiency of steam generator plants.

(2) Promote electric generation as a by-product of steam raising operations, such as paper and vulcanizing industries. This would free these operations from the need to buy electricity, and might provide surplus electricity to be used elsewhere.

(3) Promote recycling, which for nonferrous metals, requires five to ten percent less energy than is needed for primary processing. Recycling ferrous metals would require approximately one-third less energy than primary processing.

(4) Maintain electrical equipment to reduce energy loss, and improve productivity by reducing idle time.

(5) Curtail purchase of additional electrical equipment and appliances that are not necessary.

(6) Increase research, development, and marketing of more efficient electrical equipment and alternate means of achieving objectives. These would include more efficient production and transmission of electricity, development and use of solar energy and battery operated equipment, and substitution of electrical heat pumps for electrical resistance heating.

(7) Utilize environmental monitoring and control systems to more efficiently regulate temperature and humidity, especially in large buildings.

(8) Increase insulation to optimum levels in buildings, including homes, and heated and refrigerated storage and transfer systems.

(9) Improve ventilation systems in buildings, and remove air pollutants at their source rather depending on dilution by over-ventilation.

(10) Promote common district heating and re-use of steam rejected by nearby generating stations.

(11) Require minimum performance standards for appliances, equipment, and housing.

(12) Require lables on appliances, which state the level of efficiency.

(13) Re-schedule working times, especially of major consumers, to avoid peak load times.

(14) Curtail promotion of using electricity.

(15) Provide education on how to use electricity efficiently and avoid unnecessary and wasteful use. Publicize cost/efficiency ratios of marketed appliances.

and provide information regarding energy shortages and values of conservation.

(16) Provide economic, tax, and award incentives for conservation of energy.

(17) Replace promotional rates (the more one uses the less one pays per unit of consumption) with conservation rates (the more one uses the more one pays per unit of consumption).

The application of technology would require governmental actions to overcome institutional barriers to technical innovation and to promote economically optimal designs in the building industry, more efficient industrial products, and materials recycling.

Basic benefits of this approach would be that the need for nuclear power would be 80 percent of that identified under the projected growth based on past performance. Investments by the year 2000 would be approximately 300 billion dollars less than that estimated for uncontrolled projected growth. This would alleviate the possibility of a tight money situation since the investment for new power plants would be 20 percent of total income which is similar to the past few years. This approach would allow the United States to reduce fuel imports by one-half for the period of 1985 to 2000.

Application of this approach could mean that by the year 1985 the Gross National Product would be 1.5 percent less than present projected estimates, and 4 percent less in the year 2000. However, the GNP for the year 2000 would still be twice as great as for the year 1973. Potential for employment under this approach is estimated to be 1.5 percent higher than employment that is estimated for projected growth based on past performance. This increase in employment would be due to higher price for energy which would slightly modify the productive process and substitute labor for energy (Freeman, 1974).

The consumption of energy should not be controlled solely by increasing the consumptive costs or costs of fuel. Presently in the United States 60 percent of the

families (poor and lower middle income) consume only 31 percent of the energy. Whereas, forty percent of the families (upper middle income and well-off) consume 69 percent of the energy (Freeman, 1974). Controlling energy consumption by raising costs, would not reduce the consumption appreciably but could result in forcing those families on a marginal income into some form of welfare thus raising the social costs of a region or nation.

Zero energy growth

Another alternative to coping with uncontrolled growth of electrical energy would be for the nation to reach zero energy growth by the year 2000. This approach would have the same energy saving measures as those listed in the previous energy conservation section but greater emphasis would be placed on the efficiency and durability of electrical goods. More emphasis would be placed on services and less emphasis on manufacturing. Approximately two percent of the Gross National Product would be diverted through higher energy taxes to enhance quality of life.

Zero energy growth would recognize the following items:

(1) Limiting regional development.

(2) Pollution reduction.

(3) Avoiding catastrophic accidents in energy supply systems.

(4) World development considerations.

(5) Avoiding climatic alterations.

(6) Decentralizing technology.

(7) Changing attitudes and social values.

The Gross National Product for the years 1985 and 2000 would be the same as that identified in the previous energy conservation section. However, because of emphasis on services, employment in the year 2000 would be seven percent greater than estimated for uncontrolled energy growth. Zero energy growth would reduce the need for importation of fossil fuels even more than the application of technology during the period of 1985 to 2000.

At the present time there is considerable concern over the build-up of CO^2 in the atmosphere from the burning of fossil fuels. Some scientists believe that additional CO^2 in the atmosphere could cause drought in lands near the equator and lead to another ice age due to global cooling. Other scientists fear that increased surface heating would occur due to increased CO^2 content. If this happened the icecaps would melt causing flooding of low lands and disruption of agriculture.

Regardless of which theory is correct man's way of life would be drastically changed. Present estimates indicate that if the present rate of fossil fuel burning continues the CO^2 content in the atmosphere would increase by 20 to 25 percent by the year 2000.

Figure 20 compares the number of times electrical energy output could increase for the years 1985 and 2000, based on the present output for the nation and compared to the participants' projections. The national figures contain a breakdown for projected residential, commercial and industrial electrical energy growth.

Before any type of conservation measures can be implemented whether by the application of technology or zero energy growth, there must be a national energy policy adopted with an active effort by all government agencies to implement such a policy. This would require coordinated efforts in applying tax benefits for implementation of energy saving techniques, changes in pricing regulations, and regional planning for the benefit of national needs.

Based on present projections, construction of the Kaiparowits coal-fired generating plant could not be replaced by adoption of energy conservation measures. As presently proposed the power plant would begin generating electricity by 1981. If a national energy policy had already been adopted and was totally in effect now the proposed Kaiparowits generating plant would not need to go into operation until 1991. However, if a national energy policy was adopted in the near future and did not become totally effective until 1980, the Kaiparowits generating plant would have to go into operation by 1986.

FIGURE 20

Comparison of Average Electrical Energy Growth for the Participants and National Average if Conservation Measures are Implemented

	Number of Times Electrical Energy Could Increase by the Following Years as Based on Present Output	
Projected Growth Based on Past Performance	1985	2000
Nationally		
Residential[a]	1.8	2.9
Commercial[a]	1.5	2.9
Industrial[a]	2.0	4.9
National Average[a]	1.8	3.8
Participants' Average[b]	1.8	4.4
Energy Conservation by Application of Technology		
Nationally		
Residential[a]	1.2	1.8
Commercial[a]	1.2	1.6
Industrial[a]	1.1	1.7
National Average[a]	1.2	1.7
Participants' Average[c]	1.2	2.0
Zero Energy Growth		
Residential[a]	1.2	1.5
Commercial[a]	1.3	1.8
Industrial[a]	1.1	1.9
National Average[a]	1.2	1.7
Participants' Average[c]	1.2	2.0

a Developed from Ford Foundation Energy Policy Project.
b Developed from FEA Report in Appendix I-1
c Assumption made that Participants' projection would react proportionally with the nation.

Advanced generation and transmission systems

A variety of advanced concepts in central station, base-load generation and transmission are being developed. Some are closer to the point of economic feasibility than others. Some are of major significance and others represent modest improvements in efficiency.

Figure 21 lists the most promising central station and transmission techniques along with relative significance and year of availability. None of these has reached a point of development where need for Kaiparowits' 3,000 megawatts may be affected. Relative significance of a concept depends upon its potential for satisfying electric energy demand.

None of these advanced generation and transmission systems would be available soon enough to either offset or be incorporated in the Kaiparowits generating station, even if the project were delayed two to three years.

FIGURE 21

PROMISING ADVANCED GENERATION AND TRANSMISSION SYSTEMS

Concept	Potential Significance	Year of availability as an economically feasible option
Fusion	Major	after 2000
Breeder fission	Major	after 1990
Central station Solar:		
Solar thermal	Major	after 1990
Photovoltaic	Moderate-Major	1985-1990
Bio-conversion	Minor	Possibly never in Southwest due to lack of water
Wind	Moderate	after 1985
Magnetohydro-dynamics	Moderate	1990
Large fuel cells	Moderate	1990-2000
Batteries	Moderate	1985
Nuclear reactor Gas turbine (possible elimination of most water requirements in gas cooled reactors at some decrease in thermal efficiency)	Major	1990
High voltage DC transmission	Major*	1980
SE_6 insulation systems	Major*	1980
Superconduction or near-super-conduction cables	Major*	1980
UHV transmission	Major*	1980
Underwater transmission	Major*	1980

*Significance of advances in transmission technology lies in the fact that such advances mitigate siting problems by making possible greater separation between points of generation and consumption.

DELAY OR DENIAL OF PROPOSED ACTIONS

Moratorium on proposal until regional energy planning completed

The moratorium alternative assumes that the Secretary of the Interior in accordance with the National Environmental Policy Act, can delay by moratorium any federal action under his jurisdiction related to development of energy resources.

A 1972 report outlined responsibility of the Federal Government in the Southwest Energy Study Area as follows:

> "The United States Government owns or holds in trust the vast majority of the land and the coal in the Colorado River Basin. The resulting responsibilities of ownership and trusteeship require the development of the land and the underlying coal resources be undertaken in keeping with prudent governmental responsibilities for environmental management. In the interest of all of the public, every governmental action must recognize the environmental effects, avoid unacceptable damages, and minimize losses". (Southwest Energy Study, Draft April 1972.)

On May 27, 1971, Secretary of the Interior Rogers C. B. Morton established the Southwest Energy Study with these objectives:

1. To assess electrical energy need in the Southwest and adjoining areas east of the Colorado River Basin for the next 20 years.

2. To determine: (a) the practicality of fulfilling the energy needs of the southwest and adjoining areas using Colorado River Basin coal deposits; (b) the economic needs and prospects of the Colorado River Basin as affected by the development of the coal deposits; (c) the impact on cultural, social, and aesthetic factors resulting from development of Colorado River Basin coal; (d) the overall environmental impacts of development of coal resources.

3. To analyze alternatives for providing power to the Southwest and adjoining areas.

4. To study the environmental impact of long-term coal and power development within the Colorado Basin and adjoining areas.

5. To determine environmental tolerances of the Colorado River Basin for impacts involved in large scale, long-term generation of electric power. (Southwest

Energy Study, 1972, pages 1-5 to 1-6.)

To date, this study has been the most comprehensive attempt of regional energy planning. The Kaiparowits proposal was an integral part of the study and was considered in the context of the regional overview throughout the analysis.

While needs for regional energy planning are well recognized, no more comprehensive attempts beyond the scope of the Southwest Energy Study have been made. Nonetheless, relative merits and liabilities of a moratorium must be considered, in relation to the environmental impact. The primary rationale to impose a moratorium would be based on anticipated potential of avoiding adverse cumulative regional impacts caused by successive energy projects, which would outweigh the liabilities created by a moratorium.

A prerequisite to any moratorium would be assurance of cooperation with state and local governmental entities to support such a moratorium. Without such cooperation, a unilateral action by the Federal Government could be extremely detrimental to the long-term demand for close federal, state and local cooperation and coordination.

A moratorium generally appears to offer the possibility of realizing more environmental benefits over a period of time. Creation of regional goals, standards, guidelines and other needed policies to account for all interests involved would be another long-term benefit. However, none of these can go into effect without a national energy policy.

Effects of delay

Rising prices and government actions (e.g. rate restructuring or mandatory conservation) could reduce the rate of growth of demand for electric power. The date at which Kaiparowits' generating capacity would be required could be postponed.

Delay could also allow time for substantial refinements in scrubber technology and development of environmentally preferable generating technologies. However, utilities believe such technological improvements are not likely to become feasible in the near future. As discussed in the section on Investment in Energy Conservation Services of this chapter, a delay of five years could be imposed without undue hardship to society, if regional goals, standards and guidelines were developed immediately. However, Kaiparowits could replace 3,000 megawatts of oil fired generating capacity, presently requiring 80,000 barrels of oil per day.

The proposed actions might be delayed for from one to several years beyond the participants' schedule, for one or more of the following reasons: (1) litigation concerning proposed actions, (2) a moratorium imposed to provide time for further study of cumulative consequences of the proposed action and other possible projects in the region, (3) a moratorium to provide time for monitoring and studies to better assess the present environment and effects of existing generating stations and mining in the region, (4) rising prices which might result in hesitation by the participants, and (5) government actions such as rate restructuring or mandatory conservation.

The utilities believe that, unless demand growth rate is far less than is now projected, new technologies could not substitute for the proposed project as planned. If the Kaiparowits project was deferred and growth in demand occurred in accordance with the utilities' estimate, reserve generating capacity would fall below what is considered necessary to provide adequate system reliability. Figure 22 indicates forecast reserve margins in the event the Kaiparowits schedule were delayed for one year, two years, or three years. These figures assume that demand will approximate the utilities' current forecasts.

FIGURE 22

Reserve Margins

Arizona Public Service (18% of Kaiparowits output)

Year	No Delay	1 Yr. Delay	2 Yr. Delay	3 Yr. Delay
1980	20.5%	16.5%	16.5%	16.5%
81	24.9%	21.2%	17.5%	17.5%
82	20.2%	16.8%	13.3%	9.8%
83	24.3%	21.1%	17.9%	14.7%
84	24.4%	24.4%	21.4%	18.4%
85	19.2%	19.2%	19.2%	16.4%

Salt River Project (10% of Kaiparowits output)

Year	No Delay	1 Yr. Delay	2 Yr. Delay	3 Yr. Delay
1980	20.3%	17.9%	17.9%	17.9%
81	25.6%	23.4%	21.2%	21.2%
82	17.1%	15.0%	12.9%	10.9%
83	18.3%	16.3%	14.4%	12.4%
84	19.9%	19.9%	18.0%	16.2%
85	20.9%	20.9%	20.9%	19.2%

San Diego Gas and Electric (23.4% of Kaiparowits output)

Year	No Delay	1 Yr. Delay	2 Yr. Delay	3 Yr. Delay
1980	27.5%	20.9%	20.9%	20.9%
81	34.1%	26.8%	20.5%	20.5%
82	32.6%	25.9%	20.6%	14.1%
83	30.4%	30.4%	19.3%	13.7%
84	22.3%	22.3%	22.3%	12.0%
85	37.1%	37.1%	37.1%	37.1%

Southern California Edison (40% of Kaiparowits output)

Year	No Delay	1 Yr. Delay	2 Yr. Delay	3 Yr. Delay
1980	18.9%	16.8%	16.8%	16.8%
81	22.4%	20.5%	18.5%	18.5%
82	23.8%	22.0%	20.1%	18.2%
83	20.3%	18.5%	16.7%	14.9%
84	20.6%	20.6%	18.8%	17.2%
85	21.6%	21.6%	21.6%	20.0%

The 15 percent reserve margin is a partial indication that a system has adequate reserves. Figure 22 suggests that a 15 percent reserve margin could be maintained if Kaiparowits were delayed up to two years, provided other facilities were not delayed and there were power transfers among Kaiparowits participants. Delay of the Kaiparowits project would, in the utilities view, lead to insufficient reserve margin to provide adequate system reliability. The Federal Energy Administration was not provided with sufficient data for them to either agree or disagree that delay would lower system reliability below an acceptable level (See FEA report in Appendix I-1).

A potential benefit of delay would be additional time for regional planning, whether or not this were the reason for delay. Because of the analysis devoted to the Kaiparowits project in this impact statement and in the Southwest Energy Study, further regional planning studies may not affect conclusions regarding the project's location, even though such a study might affect decisions concerning the location of subsequent projects. Delay might also provide additional time for monitoring, environmental studies, and observation of socioeconomic trends in the market and impact areas.

In general, very little change in the present physical environment of the Kaiparowits Plateau and transmission system areas would be expected to occur. Recreational and socioeconomic trends may also remain much the same, that is, small increases in recreation, seasonal variation in unemployment in Kane and Garfield Counties, and declining population in Page, Arizona. However, these estimates are based on assumptions that no significant economic or other influences would occur to influence these trends, and that delay would last only a few years.

These effects, which could result from delay of the proposed project, would include both beneficial and adverse aspects. Therefore, they would need to be considered in any decision to impose a moratorium. Potential technologic improvements, comprehensive regional planning, and monitoring and analysis of environmental and

socioeconomic trends could have mitigating effects because adverse impacts of the proposed project, and perhaps those of other potential projects, could be reduced. However, this would happen only if the above events actually occurred, that is, that newer methods would result in fewer or reduced impacts, and that regional planning and monitoring were initiated, proved useful, and the results utilized.

An adverse effect of the delay would be that more oil would be burned in oil-fired generators, the amount varying according to time of delay. This is based on the participants' assumption that Kaiparowits would replace some oil-fired facilities.

Unemployment in the region might remain at its present level, increase if future events are not favorable for employment, or decrease if future events become more favorable or if many of the unemployed leave the area. In the latter case, however, the unemployed would simply be moving to other areas where they might or might not become unemployed.

Since growing energy demands can be met through the economically and technologically proven practices of building another fossil fueled plant and opening another coal mine, little incentive exists for industry or government to aggressively pursue programs or systems potentially more efficient and environmentally sound but less well proven. Therefore, any shortage of electrical energy resulting from delay of the project could have a long term beneficial impact by providing stimulus and incentive for implementation of improved systems.

The possible effects of delay involve many variables, several of which cannot be accurately predicted. These include developments in technology, regional and national economic trends, availability of oil and gas both for electric generation and automotive use, government decisions, and whether or not regional planning and studies would be initiated and prove useful. Therefore, the effects of delay cannot be accurately predicted in terms of quantity.

Denial of proposed action

Effects on participants

Introduction

The preceding section discussed effects of delay. Denial of the proposed action would extend those effects and, according to the participants, would require that more oil be burned and would further reduce the companies' systems reliability by not meeting necessary reserve margins.

The participants were asked how they would provide substitute generating capacity, including whether they would add to existing stations or sites or build new plants, in the event that Kaiparowits were denied or delayed indefinitely. The following is a summary of their responses:

Southern California Edison

Increased amounts of oil-fired combined cycle or combustion turbine units would be installed in the 1981-1983 time frame. Two reasons were given for this choice: (1) Lead time for nuclear and coal-fired generation is eight years or more, and such stations therefore could not be built in time to meet anticipated demand; and (2) 452 mw of combined cycle capacity is scheduled for operation in 1984, and this might be brought into line by 1981 if construction could be accelerated.

SCE stated, however, that additional units would be required by 1983-1984, because the 452 mw would not meet the expected need for 1200 mw, as planned in the Kaiparowits project. They also noted that if other participating utilities also install additional oil-fired capacity to replace Kaiparowits, annual fuel oil consumption would increase by about 33 million barrels.

SCE has existing generating station sites with sufficient space and water to support expansion, but doubted that this could occur because of regulatory standards and restrictions where these are located. Therefore, other sites would have to be found. However, detailed studies have not been conducted to determine suitable locations for the 23 combustion turbine units or five combined cycle units that SCE

believed would be required to replace their 1,200 mw share of the proposed Kaiparowits capacity.

San Diego Gas and Electric

San Diego officials reported they had few, if any, alternatives in case of denial or indefinite delay. They anticipate exploration of possibilities that replacement with oil-fired combined cycle units would be necessary, but doubt that these would be approved within the time frame that they believe would be necessary in order to meet expected demands. As does Southern California Edison, the company also believed future oil supplies may be uncertain, and there would therefore be a risk in choosing such alternatives.

Arizona Public Service Company

APS doubted that nuclear, geothermal, or other generating systems could be provided in the time frame of expected increases in demand. No specific sites or plans for additional generating capacity were identified.

Salt River Project

Salt River Project indicated one additional coal-fired unit at St. John's, Arizona, is planned to generate 350 mw. This unit would be in operation in 1979. No new plants are expected to be built.

Thus, the California participants indicated their alternatives in case of denial or indefinite delay would have to rely on additional oil-fired units, and the Arizona participants indicated that no specific plans have been formulated.

If the participants' assumptions as to future demands in the market areas are correct, and that the only alternatives are oil-fired electric generation, the resulting consumption of fuel-oil may increase considerably. The Federal Energy Administration (see Appendix) indicates an oil-fired station the size of Kaiparowits would consume 80,000 barrels of oil per day or about 29 million barrels annually. There are, however, no definite indications of where potential generating stations to

supply a combined total of 3,000 mw would be located.

Assuming that much or all fuel-oil needed for additional generating units would be from foreign sources, approximately $300 million per year would be spent outside the United States. If Southern California Edison's estimate of five percent annual cost differential between coal and oil is valid, the use of fuel oil to supply 3,000 mw would cost the utilities and eventually their customers an average of $21 million additionally per year in 1980-1993.

Assuming also that the participants' forecasts of future demands for electricity in their service areas are correct or that, even if they are inaccurate, the demand would increase, and that additional generating capacity were not available in sufficient time, there are implications of several other effects. These are discussed in Chapter III, particularly as socio-economic impacts in the Kaiparowits Plateau impact area and in the market areas, and in the Federal Energy Administration report, Appendix I. In general, the most notable effects could be inability to provide employment for an increasing population in the market areas, the possibility of brown-outs or even black-outs, continued decrease in the population of Page, Arizona, and no alteration of the recent employment-unemployment patterns in Kane and Garfield Counties. Increased unemployment and failure to generate new employment could be the result of lack of industrial and commercial growth because of insufficiently increasing availability of electricity and, in the Kaiparowits Plateau impact area, no employment related to the proposed project. In the market areas, the potential effects cannot be exactly determined because it is not known how people would react, whether or not some additional electricity might be available in the 1980's and how much might be generated, and whether or not energy conservation practices may be utilized (see Conservation section in this chapter).

In the Kaiparowits Plateau impact area, however, these variables would not exist. It would therefore be likely that employment trends in the area would be unchanged. Page, Arizona, may continue to decline rapidly in population to some

level near 3,000 where stabilization would occur, consisting of "permanent" residents employed at the Navajo plant, by the Federal government, and in services supporting these people and tourists. If tourism should decline because of gasoline scarcity or expense and economic recession, Page may be further depopulated. The result is that many buildings and facilities will be unoccupied and unused, and that the municipal tax base will decline still further.

Denial of the project would, however, tend to leave the natural environment of the Kaiparowits Plateau and proposed transmission system areas essentially unchanged, as discussed at the end of Chapter II. However, water, coal, and other resources would then be available for uses other than as proposed.

If denial applied only to the proposed generating station, but coal mining were to take place, the effects would depend on the extent of mining, but would be basically the same in nature as discussed in Chapters III and V-VII, except for effects directly attributable to the generating station and transmission system. It could be assumed, for instance, that if mining were conducted to the same extent as proposed--that is, nine million tons per year--the physical impacts due to mining, access highway, and limestone quarrying and hauling would be the same as described. A somewhat smaller water pipeline from Lake Powell may be needed, assuming that the participants could obtain water from Lake Powell, but the environmental disturbance would be the same except for the presently proposed extension of the line to Fourmile Bench. If a new town were developed, the impacts would also be as described previously, except that the scale might be reduced because of a total population increase of perhaps 10,000, as opposed to nearly 14,000.

However, the coal would have to be exported from the mining area if no generating station existed in the Kaiparowits Plateau area. The general nature of impacts was described in this chapter, under Alternative sites outside Utah, if coal were to be conveyed by slurry pipeline or railroad across the Colorado River near Glen Canyon Dam or west, past Kanab, to Cedar City. It is unlikely that coal could

be transported directly eastward, because of extremely rugged canyon terrain. Transportation to the north by slurry or railroad might be feasible. A route would have to be determined, however. Effects would include environmental disturbance of forested areas, impacts on Bryce Canyon National Park if the route were parallel to the proposed limestone haulage route, and possible multiple use of the railroad to transport supplies and products. The latter might stimulate tourism and encourage other industries.

Routes that might be taken to export coal would depend on where market for the coal might be found. Availability of markets and the feasibility of transporting coal would determine whether mining would be feasible. One possible use of the coal would be in an expanded Mohave generating station in Nevada. This alternative was considered in this chapter as an Alternative site outside Utah.

As presently proposed, the coal mine would use 3,100 acre-feet of water a year. Should the coal mine be the only project that goes into operation, then approximately 99,000 acre-feet of water would be available each year to be used in other projects of the Upper Colorado River drainage in Utah. The water could be used for gas liquification of coal, processing bituminous sands, processing oil shale and growth of food and fiber for an expanding population.

Alternate uses of water and coal

The State of Utah should establish priorities for any alternative uses of water appropriated for the Kaiparowits powerplant. It has been the longstanding policy of the Department of the Interior to honor priorities and wishes of the state in which the projects are located. Several water right applications have been filed with the Utah State Engineer's Office for energy related projects in the Lake Powell area. All of these applications currently have an unapproved status awaiting approval or rejection by the State Engineer. The following is a tabulation of applications for energy related projects that are seeking a water supply (see Figure 23).

FIGURE 23

Water Right Applications for Energy Related Projects
In the Lake Powell Area

Application Number	Applicant	Source of Water	Amount (Acre-feet)	Use
39721	Utah Power and Light Company	Escalante River	50,000	Steam generation, domestic
40454	Utah Power and Light Company	Escalante River	50,000	Steam generation
40592	Intermountain Consummer Power Assoc.	Escalante River	35,000	Steam generation
40670	Utah Power and Light Company	Escalante River	50,000	Steam generation, domestic
41086	Utah Power and Light Company	Escalante River	50,000	Steam generation
41138	GarKane Power	Groundwater & Fremont River	100,000	Steam generation, domestic
43124	Kaiparowits Coal and Chemical Co.	Lake Powell	100,000	Industry
		TOTAL	435,000	

The Utah Power and Light Company (Garfield plant) and the Intermountain Consumer Power Association have plans to construct coal-fired steam electric plants of 2,000 mw and 3,000 mw capacities with water requirements of 30,000 and 50,000 acre-feet, respectively. Schedules call for the plants to be in operation in the 1981-1985 time period. Approval of their water right applications would be needed prior to construction.

Coal gasification and liquification as discussed in Chapter I are also alternative uses of water for the Kaiparowits powerplant. The need for an 864 million cubic feet per day coal gasification plant is projected for the Colorado River Basin in Utah. Water for the plant (52,000 acre-feet) is part of the Kaiparowits Coal and Chemical Company filing on Lake Powell. It is expected that as demands

for natural gas increase and supplies diminish, demands for gas from coal gasification and liquification will also increase, with an accompaning demand for water to process the coal.

The many alternatives possible in the Colorado Basin make it clear there is no single solution for regional economic development or even for water development. Building dams or "making the desert bloom" by bringing in additional water are no more than alternatives. Best solution for a threatening water shortage is not neccessarily more water, but savings in water use. Transfer of water use to less consumptive, higher yield applications, or discovery of new techniques of water management may offer better solutions. Indeed, if objectives are identified, water development in itself may not be the desired solution (National Academy of Sciences, 1968).

There is presently allocated with special conditions 102,000 acre-feet of Utah's unused portion of the Colorado River water alloted to that state under the Colorado River Compact of 1948. Under Memorandum Decision No. 35818 by the Utah State Engineer, the allocation would commit a gradually increasing amount of water, up to the total 102,000 acre-feet in 1989, and then reallocate this water by agreement to the Central Utah Water Conservancy District for the purposes of the Central Utah Project (See Chapter I).

Resources, Inc., negotiated a water sales contract with the U. S. Department of the Interior through the Secretary, whereby the participants obtained the right to use water out of Lake Powell in the amount of 102,000 acre-feet, subject to limitations set forth in the contract. In addition, Resources, Inc., applied with the State of Utah to use such water in order to have the state's concurrence following its responsibilities under the Colorado River Compact to allocate its proportionate share of water in the Upper Colorado River Basin.

Utah is responsible for allocation of its share of water in the Upper Colorado River Basin throughout those portions of the state related to the Colorado

River drainage. As a result of responsibility and restrictions of the compact, when Utah, in the use of its waters under the compact, makes a commitment for the use of 102,000 acre-feet of water on Kaiparowits Plateau out of Lake Powell, such action forecloses the use of the same amount of water at some other point in the state.

If the decision is made to allow development of the Kaiparowits proposal, this commitment forecloses alternative uses of the water for the time period detailed in the agreement, excepting other minor uses associated with the power development (See Chapter I for a further analysis of water interrelationships).

The Kaiparowits project would also consume coal which might be used for purposes other than generation of electric power. Because coal reserves are abundant, the use of coal for electric power generation does not, at present, compete with the use of coal for other purposes such as gasification or liquefaction.

The 9,000,000 tons of coal that would be consumed by the Kaiparowits power plant each year could be utilized in a coal gasification plant to produce 245 million cubic feet per day of gas. However, such a gasification system would require a water consumptive rate of 4,676 gallons a minute or 7,550 acre-feet a year (Bureau of Reclamation, 1974).

KAIPAROWITS

ENVIRONMENTAL IMPACT STATEMENT

CHAPTER IX

CONSULTATION AND COORDINATION

Draft

CHAPTER IX

CONSULTATION AND COORDINATION

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CHAPTER IX

CONSULTATION AND COORDINATION

This chapter includes a brief history of consultation and coordination undertaken concerning this statement, organization of the interagency team, agency contacts, adherence to mandatory federal laws, significant meetings held, and a list of organizations who will receive a copy of the statement and be requested to submit written comments. Written comments will also be accepted and considered from any other interested parties.

HISTORY OF CONSULTATION AND COORDINATION

By memorandum dated January 14, 1974, the Secretary of the Interior assigned the Bureau of Land Management lead responsibility for preparing an environmental impact statement on the proposed Kaiparowits project. As a result, the Associate Director, Bureau of Land Management, by memorandum dated January 25, 1974, directed the Utah State Director, to prepare the Environmental Impact Statement. Subsequently, by memorandum dated March 6, 1974, the Utah State Director requested formal assistance from the National Park Service, the Bureau of Sports Fisheries and Wildlife, Bureau of Reclamation, the Bureau of Mines, the Bonneville Power Administration, and the U. S. Geological Survey. Shortly thereafter, by memorandum dated April 17, 1974, the Utah State Director set out the assignments and responsibilities necessary for completing the statement to all members of the interagency team.

The Bureau of Land Management received project proposal information as follows: The companies submitted their revised description of alternatives October 24, 1974. Final submission on description of proposed project was received November 4, 1974. The new highway proposal was received with cover letter dated November 21, 1974. The new town description was received December 4, 1974. The description of new town site alternatives was received January 6, 1975. Finally, the companies submitted a modification on the routing of the western transmission system as well as modification of the Nipple Bench site alternative, which was received April 4, 1975.

The first preliminary draft was completed November 19, 1974. Consequently, an interagency review was held December 2 - 6, 1974. A second preliminary draft statement was submitted to the Department of the Interior for review January 30, 1975. The Department's review of the second preliminary draft was completed February 28, 1975.

By memorandum dated April 23, 1975, the Deputy Undersecretary directed the Interior agencies to submit comments on the draft statement by May 9, 1974. See section Consultation and Coordination in the Preparation of the Draft Environmental Statement - Federal contacts for additional information regarding the extent of federal participation.

ORGANIZATION OF INTERAGENCY TEAM FOR PREPARATION OF THE DRAFT STATEMENT

The primary interagency team effort involved Bureau of Land Management, U. S. Geological Survey, Fish and Wildlife Service, Bureau of Mines, Bureau of Reclamation, U. S. Forest Service, and National Park Service.

On March 18 and 19, 1974, and EIS Team was organized under the Divison of Resources, Utah State Office, Bureau of Land Management. Soon thereafter, conceptual plans and management techniques for the project were developed, including selection of team members, preparation of an outline, assignment of responsibilities, and scheduling of future activities.

Under supervision of a program manager, three working groups were established. Members of the Kaiparowits Plateau impact area groups were from the U.S. Geological Survey, National Park Service, Fish and Wildlife Service, Bureau of Mines, Bureau of Outdoor Recreation and Bureau of Reclamation. The transmission system impact area group received support from Fish and Wildlife Service and U.S. Forest Service. The limestone quarry impact area group received support from National Park Service, U. S. Forest Service and the State of Utah. The groups represented broad categories of environmental concern, including air quality, soils and vegetation, wildlife, socio-economics, hydrology, geology and mining, land uses, recreation values and ecological interrelationships.

The three groups were located in the Federal Building Annex in Salt Lake City, Utah. They utilized an interdisciplinary team approach in their analysis and writing activities during preparation of the statement. Group membership totaled approximately 55 persons in the beginning of the project. This number was reduced to about 20 for final preparation of the draft statement.

Periodic review was provided by representatives of BLM, Office of Environmental Project Review, and Office of the Solicitor, Department of Interior. All reviews to assess technical and legal adequacy, as well as progress, were conducted in Salt Lake City.

CONSULTATION AND COORDINATION IN THE PREPARATION OF THE DRAFT ENVIRONMENTAL STATEMENT

Federal contacts

On July 2, 1974, Interior agency officials met with the utility companies' representatives to discuss information that had to be submitted as the basis for the environmental impact statement. An initial review and organization meeting was held July 15, 1974. Interior agencies, Office of Environmental Project Review, Solicitor, the companies, and State of Utah were represented. A meeting was held July 25, 1974, to discuss highways required for the project. Utah State officials and the National Park Service attended. On August 28, 1974, Interior and company representatives met to review the companies' project description. A second meeting for review of the companies' proposal was held September 19, 1974. The chart below lists the Interior and non-Interior agency contacts' latest comments regarding the interim draft statement prepared and submitted for comment in January, 1975. The Interior agencies' comments, were in accordance with the Undersecretary's memorandum of April 23, 1974, directing responses by May 9, 1975.

Agency	Comments Received	Action Taken to Incorporate Comments in the Draft
Department of the Interior		
Fish & Wildlife Service	Yes	No action necessary
National Park Service	Yes	No action necessary
Solicitor	Yes	Incorporated
Bureau of Indian Affairs	Yes	Incorporated
Bureau of Reclamation	Yes	Incorporated
Bureau of Mines	Yes	Incorporated
U.S. Geologic Survey	Yes	No action necessary
Bureau of Outdoor Recreation	Yes	No action necessary
Department of Agriculture		
U. S. Forest Service	Yes	Incorporated

Environmental Protection Agency

Environmental Protection Agency, Denver, Colorado, was consulted and notified in compliance with the Clean Air Act.

Fish and Wildlife Service

In conformance with the Fish and Wildlife Coordination Act, Endangered Species Act, and Bald Eagle Protection Act, the Fish and Wildlife Service offices in Utah, Arizona, Nevada and California were consulted in preparing this statement. They indicated that there were no jurisdictional problems in the statement.

Bureau of Outdoor Recreation

Bureau of Outdoor Recreation was contacted in the development of the recreation sections of the statement and indicated the statement was in compliance with the Land and Water Conservation Fund Act (Section 6), Wild and Scenic Rivers Act, and National Trails System Act.

Federal Highway Administration

Federal Highway Administration has been informed concerning development of the statement.

State and local contacts

State Historic Preservation Officers in Utah, Arizona, Nevada and California were contacted in compliance with the National Historic Preservation Act. Officers contacted were Mr. Melvin T. Smith (Utah), Ms. Dorothy H. Hall (Arizona), Mr. Eric R. Cronkhite (Nevada), and Mr. Russell W. Porter (California). Their responses were received and considered in preparing the statement.

Utah

State

A close working relationship was established with state and local agencies

in Utah. The Kaiparowits Planning and Advisory Development Council (an agent for state and local authorities), has been kept informed consistent with their jurisdictional interests in the Kaiparowits project. All divisions of Utah State Government having jurisdictional interests in the project have been contacted and supplied statement data. A complete list follows:

Office of the Governor
Planning Coordinator
Department of Community Affairs
Utah Road Commissioners
Highway Department
Utah Highways Environmental Council
Division of Parks and Recreation
Division of State Lands
Division of Water Resources
Division of Wildlife Resources
Division of Water Rights
Division of Health, Air Quality Section
Tax Commission
University of Utah
Utah State University (BLM consultant)
Weber State College (BLM consultant)
Industrial Promotion

Local

County Commissioners in Kane and Garfield Counties have been consulted regarding preparation of the statement. The city of Cannonville has been consulted also.

Arizona

The following state and local agencies have been contacted in preparation of the statement.

State

Clearing House
Lands Department
Parks Board
Game and Fish Department, Phoenix Office
Arizona Corporation Commission, Utilities Division
State Water Commissioner
Northern Arizona University
Bureau of Mines
Highways Department
Department of Health, Air Quality Section

Local

Planning Department, Mohave County
Parks Department, Mohave County
Planning Department, Coconino County
Parks Department, Coconino County
Planning Department, Yavapai County
Parks Department, Yavapai County
Planning Department, Maricopa County
Parks Department, Maricopa County
Mohave County Museum at Kingman
City Clerk, City of Page

Nevada

The following agencies have been contacted in preparation of the statement.

State

Clearing House
Department of Fish and Game
University of Nevada at Las Vegas

Local

Clark County Planning Department

California

The following agencies have been contacted in preparation of the statement.

State

Clearing House
Resources Agency of California,
    Department of Food and Agriculture
    Department of Transportation
    Department of Conservation
    Department of Fish and Game
    Department of Parks and Recreation
    Department of Water Resources
Water Resources Control Board
Colorado River Board of California
Public Utilities Commission
University of California at Riverside,
    Archaeological Research Unit
University of California, Santa Barbara - (BLM consultant)

Local

Board of Supervisors, Riverside County
Parks Department, Riverside County
Planning Department, Riverside County
Airports Department, Riverside County
Board of Supervisors, Orange County
Planning Department, Orange County
Planning Department, City of Orange
Board of Supervisors, San Bernardino County
Planning Department, San Bernardino County
Environmental Improvement Agency, San Bernardino County
Curator of Earth Sciences, San Bernardino County Museum
Department of Parks and Recreation, Los Angeles County
Planning Division, San Diego County
Park Development Division, San Diego County
Southern California Association of Governments

Other contacts

During March, 1974, a letter from the Utah State Director was sent to Utah conservation and environmental organizations and other concerned groups announcing the Kaiparowits project and requesting their views and participation in preparation of the statement.

On May 7, 1974, a public meeting on the Kaiparowits power project was held in Salt Lake City, Utah. Conservationists, environmentalists, state and local government officials, company representatives and BLM officials attended.

The Navajo Nation has been consulted in preparation of the draft statement. The official representative of the Navajo Nation was present at the Interagency review sessions. He provided the transmission system group with information concerning the impact of the transmission system on Navajo Lands.

The John Muir Institute for Environmental Studies, Lake Powell Research Project, and Western Systems Coordinating Council were also consulted.

COORDINATION IN REVIEW OF DRAFT STATEMENT

Federal

This is a list of all organizations who will receive a copy of the statement and be requested to submit written comments.

Department of Transportation

Department of Agriculture

Forest Service

Soil Conservation Service

Environmental Protection Agency

Department of the Interior

Bureau of Reclamation

Bureau of Outdoor Recreation

Fish and Wildlife Service

U.S. Geological Survey

National Park Service

Bureau of Indian Affairs

Bureau of Mines

Mining Enforcement and Safety Administration

Office of Oil and Gas

Office of Coal Research

Office of Land Use and Water Planning

Office of Water Resources Research

Office of the Solicitor

Power Marketing Administration

Office of Saline Water

Federal Power Commission

Department of Health, Education and Welfare

Atomic Energy Commission

Federal Energy Administration

Department of Commerce

National Oceanic and Atmospheric Administration

Tennessee Valley Authority

Federal Aviation Administration

National Historical Advisory Council

Army Corps of Engineers

Upper Colorado River Basin Commission

Department of Housing & Urban Development

Department of Labor, Occupational Safety & Health Administration

State

State of Utah

Governor's Clearing House

Mr. Blaine J. Kay, Director, Utah Department of Highways

State of Arizona

Governor's Clearing House

State of Nevada

Governor's Clearing House

State of California

Governor's Clearing House

Local

Board of County Commissioners

Washington (Utah)

Garfield (Utah)

Kane (Utah)

Coconino (Arizona)

Yavapai (Arizona)

Maricopa (Arizona)

Mohave (Arizona)

Clark (Nevada)

Lincoln (Nevada)

Orange (California)

San Bernardino (California)

Non-Government organizations

Sierra Club

Utah Audubon Society

Izaak Walton League - Utah Division

Rocky Mountain Center on Environment

National Stock Growers Association

Utah Wool Growers Association

Utah Mining Association

The Wilderness Society

Environmental Defense Fund, Rocky Mountain/Great Plains

The Institute of Ecology

Natural Resources Defense Council, Inc.

Enchanted Wilderness Association

Escalante Wilderness Committee

Utah Environment Center

Wasatch Mountain Club

Utah Water Users Association

Rocky Mountain Federation of Mineralogical Societies

Women's Conservation Council of Utah

Utah Nature Study Society

Archaeological Society of Utah

Rocky Mountain Sportsman Association

Utah Wildlife and Outdoor Recreation Federation

Mineralogical Society of Utah

Pro-Utah, Inc.

Utah Geological and Minerals Survey

Utah Sportsman Association

Defenders of the Outdoor Heritage

Utah Cattlemen's Association

Save Our Canyons Committee

Advisory Commission on Arizona Environment

Arizona Archaeological Society, Inc.

Colorado Plateau Environment Advisory Council

Arizona Cattle Growers Association

Arizona Conservation Council

Arizona Desert Bighorn Sheep Society, Inc.

Arizona Environmental Education Council, Inc.

Arizona Mining Association

Arizona Wildlife Federation

Arizona Wool Growers Association

Arizonans in Defense of the Environment, Inc.

Common Cause

Environmental Awareness

Environmental Council of Arizona

Defenders of Wildlife

Good Earth

Mearns Wildlife Society

National Wildlife Federation

Nature Conservancy

Western Rockhound Association

Friends of the Earth

Tucson Wildlife Unlimited, Inc.

SWRCC Wilderness Society

Nevada Wildlife Federation

Wild Horse Organized Assistance

Nevada Conservation Forum

Conservancy Resource Center

Desert Protective Council

California Wildlife Federation

Society of Conservation of Bighorn Sheep

Inland Com. Conservation Clubs

Ecology Center of Southern California

Utah Lung Association

Council on Utah Resources

Canyon Country Coalition

League of Women Voters

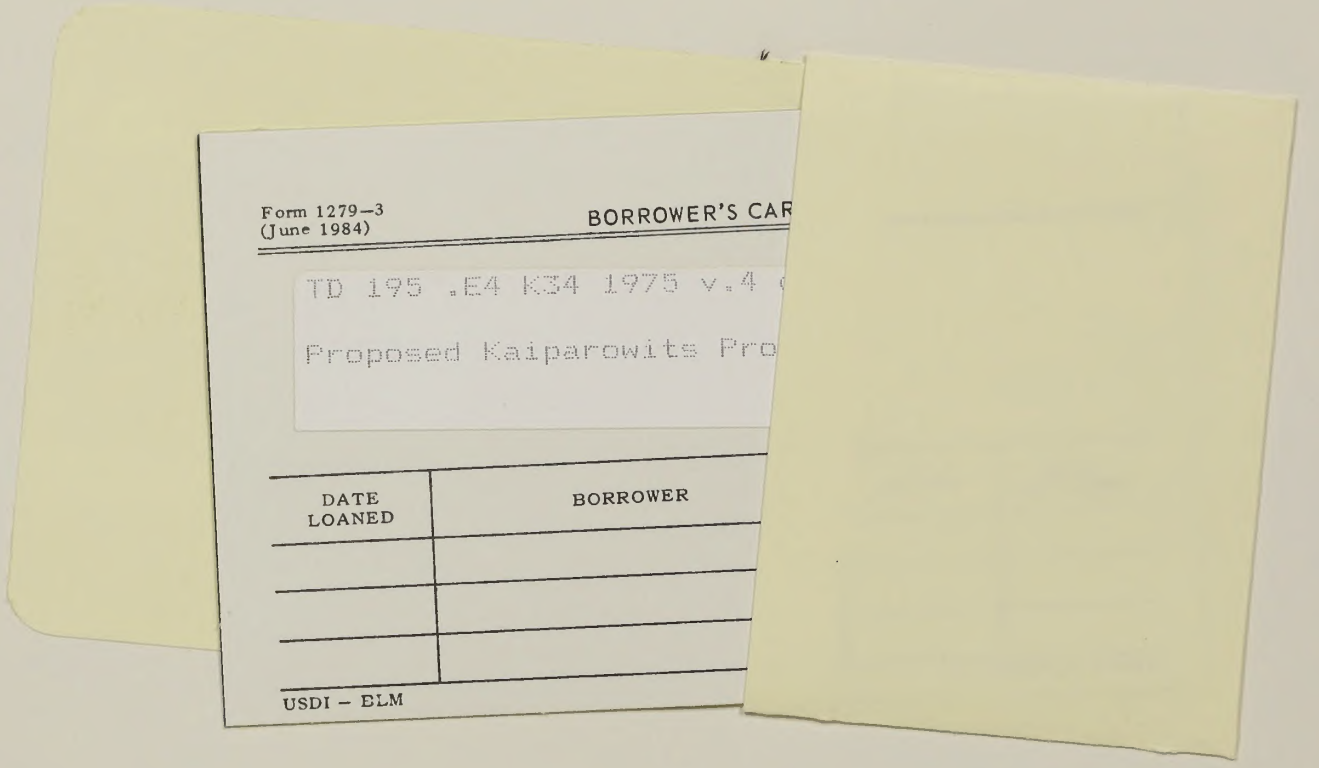
Museum of Northern Arizona

Utah Farm Bureau

Public Hearings

Public hearings will be held at various locations in the states which would be affected by the proposed project.

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(June 1984)
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Proposed Kaiparowits Pro
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U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849